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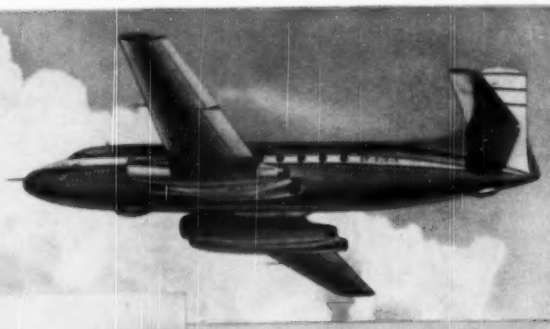

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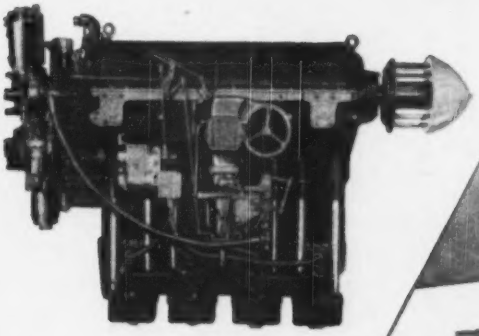

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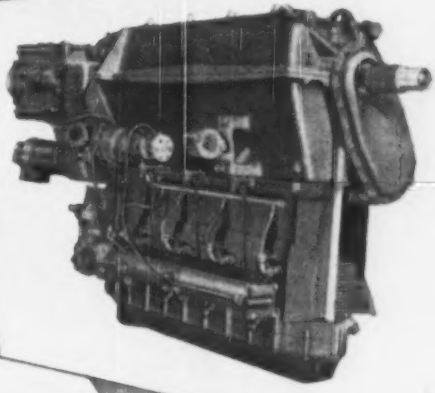

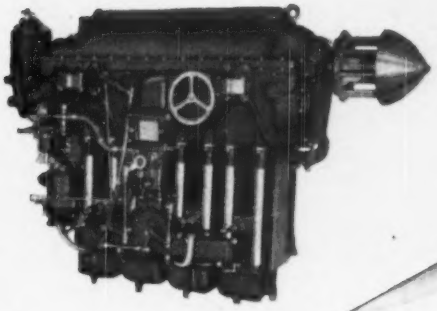

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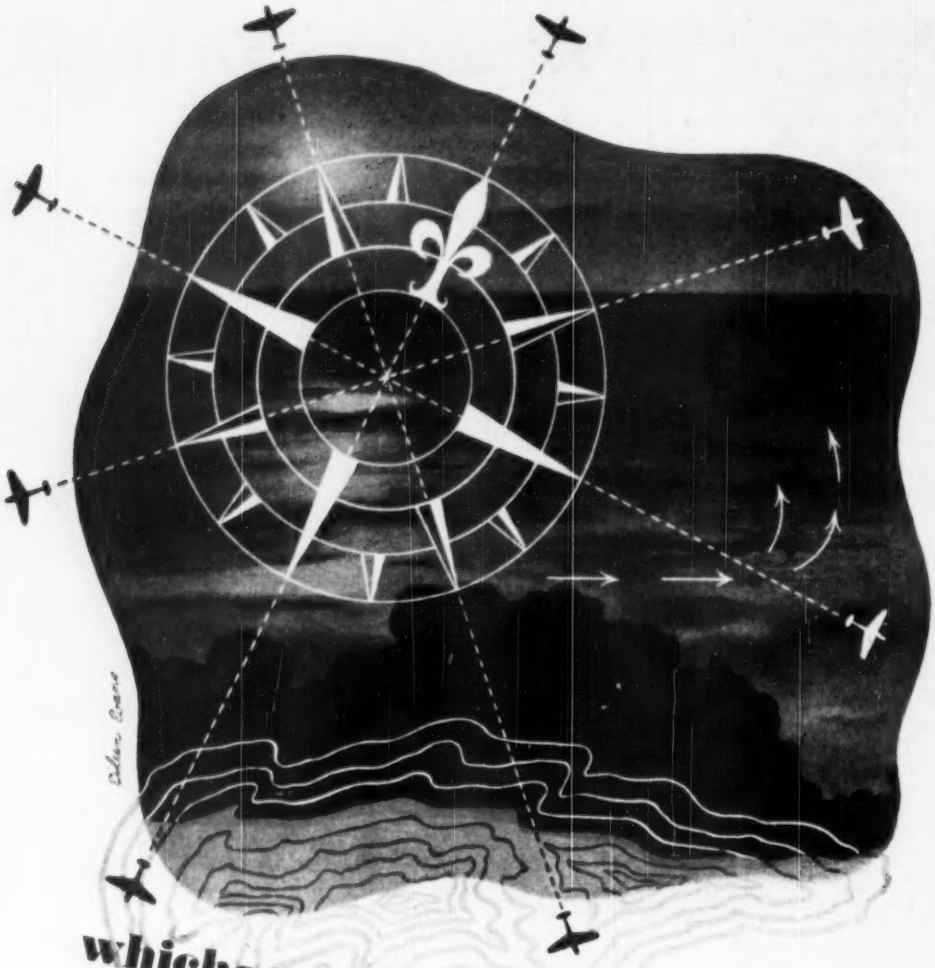

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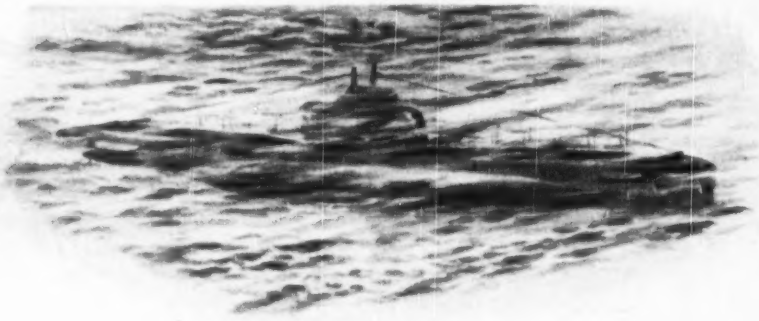

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B-29s for Bomber Command

IT is with mixed feelings that British aviation has received news of the allocation of seventy Boeing B-29 bombers to the R.A.F. The announcement has come as something of an anti-climax, for the possibility was discussed many months ago. At that time it seemed strange that, while the R.A.F. was in real need of a stop-gap bomber, the United States authorities should be cocooning many hundreds of B-29s with little likelihood of their ever being used again. One thing was clear—namely, that we could not afford to buy any of them for dollars. Now the initial-cost problem at least has been solved, for the seventy, and perhaps more later, are to be allocated to R.A.F. Bomber Command under the Atlantic Pact mutual arms aid agreement signed in Washington on January 27th.

On receipt of the B-29s the problem of keeping them serviceable and in operational trim will have to be faced. The fact that they are to be operated for a start from Marham, Sculthorpe and Lakenheath—airfields where the U.S. Third Air Division is already in occupation—will go a long way towards solving the problem for the time being. As against this, it must be realized that it will not only take time to train ground crews but, in view of the great shortage of these tradesmen throughout the Service, it will not be easy to find a sufficiency of men to train. The B-29 is a large and complicated aircraft by comparison with the Lincoln or Lancaster, and every detail of equipment, in addition to the airframe, engines and services, will be new to the R.A.F. ground crews.

Aircrews will almost certainly look forward to operating for a year or two this more advanced, though far from new, piston-engined bomber. It will give the squadrons the ability to strike more heavily at a worth-while range, and will add ten thousand feet to their operational altitude. They will also gain experience of pressurized, long-range operation in readiness for British jet bombers now under construction. Gunners—a fully manned B-29 may carry up to five—will also welcome these aircraft as offering new opportunities for their trade.

No useful purpose can be served by lamenting the introduction of American Service aircraft into the R.A.F. at this time. In spite of the fact that the British industry is very capable of fulfilling our needs, the disquieting facts regarding cost, the export drive and available manpower are well known; nor must it be forgotten that in 1945 there was no urgency to start developing new heavy bombers, and turbojets were barely out of the experimental stages; consequently, designs and prototypes are only now beginning to take shape. The allocation of B-29s at this time does not reflect a worsening of the international situation during the past year, nor does it indicate an avoidable misjudgment on the part of those responsible for specifying and ordering aircraft against an estimate of the probable time of greatest war risk.

In general, then, while regretting that no suitable new British aircraft could be available to Bomber Command for service at the present time, we must be grateful to America for allocating to us a number of very useful interim bombers which will give R.A.F. crews valuable experience and in an emergency enable them to strike an enemy at ranges considerably greater than has hitherto been possible.

Effects of Reduced Defence Expenditure

Concurrently with the allocation of B-29s to the R.A.F. come details of how the £30,000,000 cut ordered last October in defence expenditure will affect the aircraft industry. Provision of jet fighters still holds the highest priority, and progress made in equipping the priority command with aircraft of the latest type permits no complacency, particularly when compared with the rate of American and Russian development. Bomber development, such as it is, leaves no room for economy, and thus Transport Command has had to accept the principal cuts. The aircraft industry must inevitably suffer in turn; and orders have already been curtailed.

This particular ill wind, however, will blow kindly in at least one direction, for in future it will almost certainly be expedient for the R.A.F. to co-operate more closely with the civil transport companies, both private and State-operated.

Outsize pioneer: Sikorsky's *Ilia Mourometz* passenger aircraft, based on his four-engined machine of 1913. Wing span was 102ft.

SIZE IS RELATIVE

How Big is Big? The Brabazon Prompts Some Thoughts on "Giant" Aircraft that Caused Discussion in the Past

By Geoffrey Dorman, A.R.Ae.S.

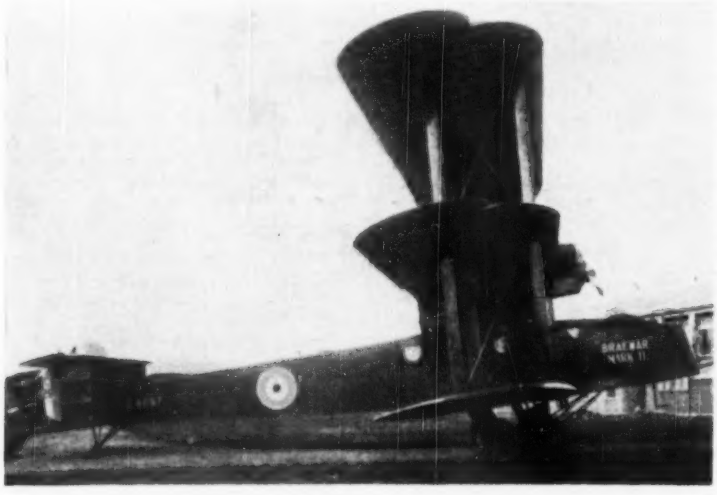
THOUGH the Bristol Brabazon has now shown remarkable flying qualities, we still occasionally hear the view expressed that it is "too big to be of any practical use." My own reaction is that its construction may very well prove to be a case of real foresight—of having ready an aircraft of a size which will be needed three or four years hence. And foresight is a commodity which has been sadly lacking throughout civil aviation in the past.

I can vividly remember how, during the past 40 years, the aeronautical world has been surprised, and even shocked, by the occasional appearance of an aircraft far bigger than its contemporaries. Yet, as the years have unfolded, we have soon come to look back on such machines as comparatively small.

"The first of the huge" came from that country of mysteries, Russia, in 1913, when Igor Sikorsky—long since a naturalized American and inventor of the practical helicopter—produced a biplane powered by four German Argus engines, each of which developed 100 h.p. This machine, which was called the Grand, was wrecked during the Russian Army manœuvres in 1913.

From the remains, Sikorsky built another which might fairly be called the first airliner, except that there were then no airlines on which it could fly. It was named *Ilia Mourometz* (Prophet Elijah). The span was 102ft—that of a Lancaster—but, as the aircraft was a biplane, its wing area was far greater, namely, 17,000 sq ft. Gross weight was slightly more than 10,000 lb.

The front upper part of the fuselage contained what would now be styled the "flight deck" and it provided a roomy pilot's compartment. No one had considered having a seat for a second pilot in those days, except in school machines, and no one envisaged such luxuries as navigators, radio officers, flight engineers, or stewards. Nevertheless, Sikorsky showed foresight of a kind which was not general until six years later. He provided a passenger cabin with four large windows on each



An early "giant" from the Bristol Company was the Braemar triplane of 1919. It was redesigned as an airliner.

side. Farther aft ran a passage with an entrance door and a stairway to an upper deck. There was a toilet compartment right aft. Forward, below the "flight deck," was a private cabin with a berth, a small table and a toilet. The interior was lighted for night flying, by electricity supplied by a wind-driven generator.

The top wing had "overhang" extensions—a common feature on biplanes of those days—and the metal fuselage was rectangular in section. The undercarriage carried two pairs of wheels and two pairs of skids, the latter being wooden affairs shaped rather like hockey sticks of the kind with which most aircraft of the period were fitted to prevent them from nosing-over when landing. (Probably the last aircraft with such a skid, incidentally, was the Avro 504K.) The pilot controlled the Sikorsky by means of a wheel and column of the type in wide use to-day and by a foot-actuated rudder bar.

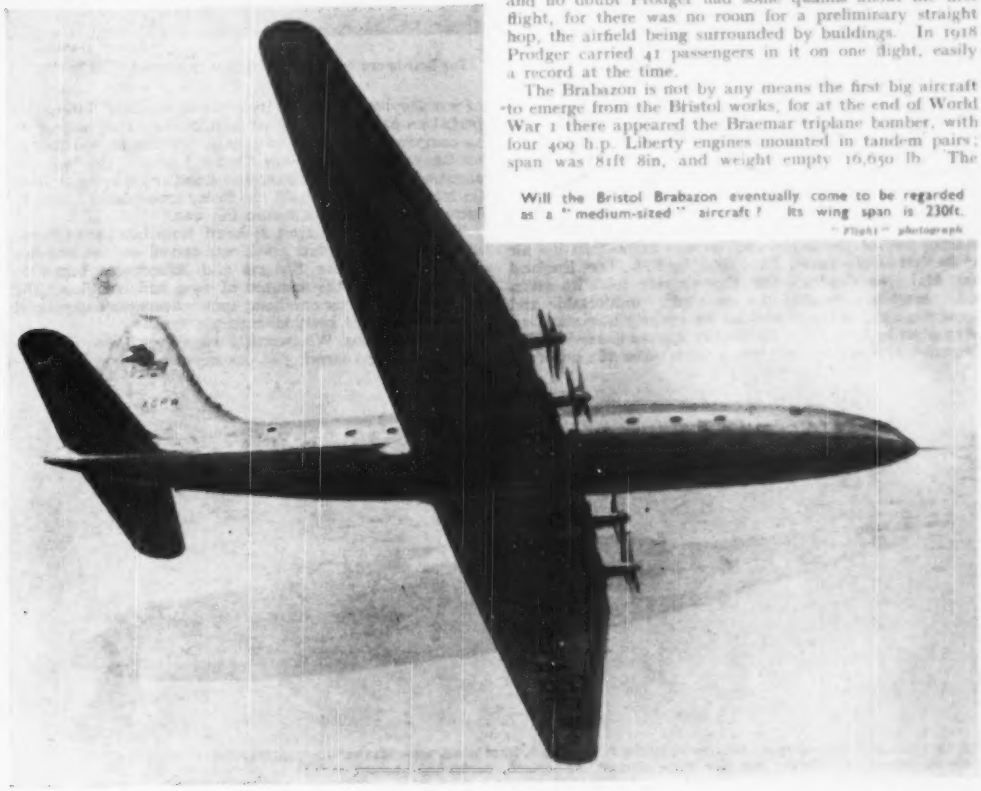
The big biplane flew in 1913 for 1 hr 4 min with a pilot and seven passengers, and in 1914 lifted 16 passengers and also flew from St. Petersburg (now Leningrad) to Moscow, about 200 miles, in 1 hr 54 min. The outbreak of war in August, 1914, prevented further development of this apparently quite successful "giant." Stories about its performance were received with doubt at the time.

The next really big practical aircraft was the famous Handley Page 0/400 bomber. The prototype, the 0/100, was first flown from Hendon in 1915 by Sqn. Cdr. J. T. Babington, R.N.A.S., who is now known as Air Marshal Sir John Tremayne. Then came the Handley Page V/1500, designed to attack Berlin—a biplane with a span of 128ft and powered by four Rolls-Royce Eagles of 350 h.p. each. It was tested from a small grass airfield at Cricklewood at the end of 1917 by an American domiciled in Britain. His name was Clifford Prodger; in partnership with Bernard Isaacs as business manager, he was the first man to become a "free-lance" test pilot. The V/1500 was considered a colossal machine at the time and no doubt Prodger had some qualms about the first flight, for there was no room for a preliminary straight hop, the airfield being surrounded by buildings. In 1918 Prodger carried 41 passengers in it on one flight, easily a record at the time.

"Flight" photograph.

The Handley Page V/1500 was designed to raid Berlin. Here, two are seen performing at the first R.A.F. Display, in 1920.

The Brabazon is not by any means the first big aircraft to emerge from the Bristol works, for at the end of World War 1 there appeared the Braemar tripdane bomber, with four 400 h.p. Liberty engines mounted in tandem pairs; span was 81ft 8in, and weight empty 16,650 lb. The



Will the Bristol Brabazon eventually come to be regarded as a "medium-sized" aircraft? Its wing span is 230ft.

"Flight" photograph

SIZE IS RELATIVE . . .

cruising speed was 113 m.p.h. at 10,000ft. The Armistice came, so the Braemar never saw active service. Shortly afterwards, it was redesigned for civil use, with a fully enclosed cockpit and a 14-passenger cabin of—for those days—considerable luxury; the payload was 2,700 lb for a five-hour flight at a little over 100 m.p.h. The civil version was lost in a crash at Martlesham in 1920.

The next big step came in 1928 when S/L. Jack ("Oogy") Noakes tested the Beardmore Inflexible at Martlesham Heath. With a span of 158ft and weighing 15 tons, the Inflexible was the biggest and heaviest aircraft in the world. But it was very lightly loaded, and Oogy told me he had no fears for its first flight. It took off in less than 100 yards from the rough grass common land at Martlesham.

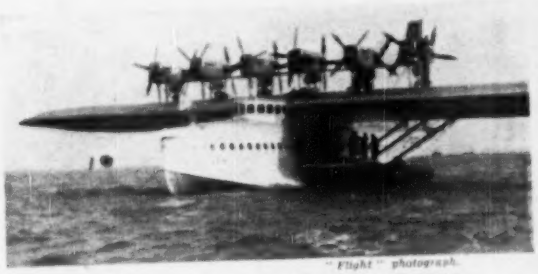
Between the appearances of the V/1500 and the Inflexible other big aircraft had been built but had never flown. For example, there was the Tarrant Tabor triplane assembled at the Royal Aircraft Establishment from braced-wooden-girder components made by a woodworking firm. The aircraft was powered by six Napier Lion engines of 450 h.p. each: one set of two, in tandem, were placed at fuselage level on each side and drove tractor and pusher airscrews; the remaining two engines, mounted above, drove tractor airscrews. The middle wing had a span of 131ft and the upper and lower wing were each of 98ft. The maiden flight began at Farnborough in May, 1919, with Sgt. Plt. "Dusty" Dunn at the controls. He taxied out on the four lower engines; when he opened up the two upper units to take off, the coupling moment caused the whole triplane to nose over. It caught fire, and Dunn and the co-pilot, Capt. P. T. Rawlings, lost their lives.

In 1934 the Russians produced—for propaganda purposes, as freely acknowledged—the vast A.N.T. 15 *Maxim Gorki* monoplane with eight 780-850 h.p. engines, a span of 210 ft and payload of seven tons. On board were a printing press, "editorial offices," photographic dark-room, cinema apparatus and a public-address system. A "staff" of 40, and 70 passengers, could be carried at a cruising speed of 137 m.p.h. The *Maxim Gorki's* career was abruptly and tragically ended by an air collision in 1935 with the loss of 48 lives.

In this country the next big aircraft was the Handley Page H.P. 42 class—the largest passenger aircraft in the world, seating 40 passengers. The first flight of this 130ft-span biplane had been awaited by sceptics with something of the same sort of doubt which awaited the maiden trip of the Brabazon. It was taken into the air at Radlett on November 17th, 1930, by S/L. Tom England and Maj. Jim Cordes. But this aircraft, with its seven sister machines, became the most safe, comfortable and economic airliner in use and set an entirely new standard of comfort in air travel. The fleet continued in service with Imperial Airways for nine years (even after the outbreak of war they were used, as troop transports) and during this period no passenger was ever hurt in one. They were slow as compared with today's speeds, cruising at 100 m.p.h. on the power of their four Bristol Jupiters; this was the standard cruising speed on the London-Paris route from its inception in 1919 until the faster monoplanes began to come into service just before the war.

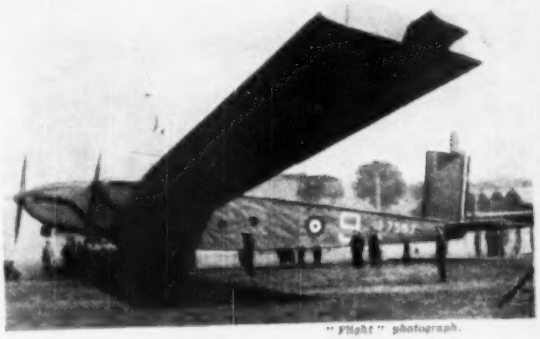
The H.P. 42s averaged 2½ hours from London to Paris, and a very substantial lunch was served on the mid-day service. When the Ensigns and Albatrosses began to replace them in the summer of 1939 and completed the journey in just over one hour, some passengers complained that they did not get their money's worth!

The Armstrong Whitworth Ensign (1937) was a 123ft-span monoplane carrying 40 passengers and showing a con-



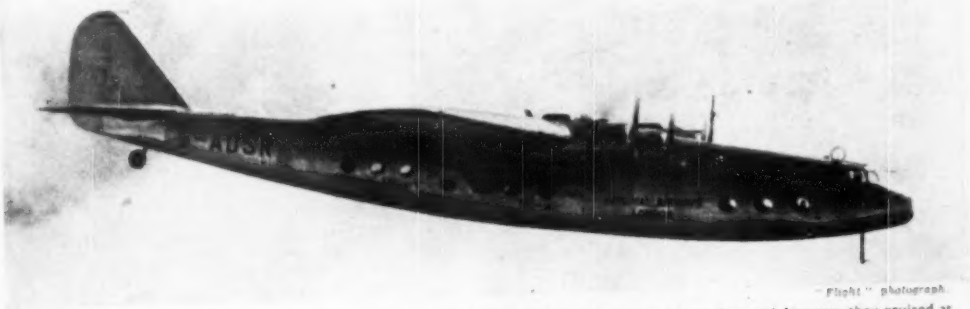
"Flight" photograph.

First of the big flying-boats: the Dornier Do.X of 1930.



"Flight" photograph.

The Beardmore Inflexible of 1928 was nicknamed "The Brittle."



"Flight" photograph.

A big increase in airliner speed was shown by the A.W. Ensign, 14 of which went into service with Imperial Airways; they cruised at up to 170 m.p.h. During the war these aircraft, re-engined, performed yeoman service in carrying supplies across Africa.

"Flight" photograph

Slow but reliable: the H.P. 42s gave many years of faithful service on Imperial Airways routes. Passengers appreciated their comfort.

siderable advance in speed, its four Armstrong Siddeley Tigers giving a maximum cruising speed of 170 m.p.h. In many respects it was the prototype of modern airliners, and its first flight, in the hands of Charles Turner Hughes, made the headlines in the daily papers. Fourteen of them were delivered, and they finished their career with valuable war-service.

In June, 1938, the prototype Douglas DC-4 (138ft span, 66,500 lb a.u.w.) made its first flight. Though the production aircraft which followed were admittedly somewhat smaller, no one who saw the great number of DC-4s performing regularly on the Berlin Air Lift nine years later could have credited how fearsome a monster it was considered to be when it first flew. Yet the DC-4 today is now classed among medium-size aircraft!

The large flying-boats have never aroused such speculation over their prototype flights as have the landplanes—mainly, perhaps, because water provides almost unlimited take-off and alighting space. The first really big flying-boat was the Curtiss-Wanamaker *America*, designed in 1913 to fly the Atlantic. When war came in 1914 preparations for the flight were abandoned. Lt. Cdr. John Porte, R.N., who had helped with the design, took over the boat on behalf of the British Admiralty, and from it were evolved the series of "F" (for Felixstowe) boats which gave such fine service in the first war, comparable with that given by Sunderlands in the more recent struggle. The F.2 had a span of 102ft, and two 350 h.p. Rolls-Royce Eagles gave it a speed of 85 m.p.h.

From the F.2 the *Felixstowe Fury* was developed. She was a triplane, the span of whose two upper wings was 125ft, or 2ft bigger than the span of a Constellation. All-up weight was 23,400 lb. Power was derived from five Rolls-Royce Eagles which had been tuned to give 375 h.p. each.

The first flight was made by Maj. Arthur Cooper on November 11th, 1918, as the maroons were signalling the Armistice. So great was confidence in the big flying-boat that six of those who had helped in the design went as passengers for the fun of it. Some months later the *Fury* was wrecked when taking-off, much overloaded with petrol, for a non-stop flight from Plymouth to Lisbon.

In 1930 the world was amazed by the appearance of the Dornier Do. X. This was a great monoplane flying-boat with a span of 157ft 5in, powered at first by 12 German-built Bristol Jupiter engines mounted in a row of six tandem pairs above the wing. It was probably the noisiest aircraft, from the passengers' point of view, that has ever been built. Later the Jupiters were replaced by water-cooled Curtiss Conquerors, because the air-cooled units did not get a sufficiently strong airstream to cool them—the Do. X was very slow. After many vicissitudes, it flew across the Atlantic and back, and gave Berliners their first sight of a flying-boat by alighting on the Havelsee—on which Hythes and Sunderlands of the Air Lift were to operate nearly 20 years later. Two more Do. Xs were built and sold to Italy.

Three years later Britain produced the Short R6/28 or Sarafand, runner-up to the Do.X as the world's largest flying-boat. Powered with six 810 h.p. Rolls-Royce Buzzards, it had an all-up weight of 70,000 lb; the span of its biplane wings was 120ft.

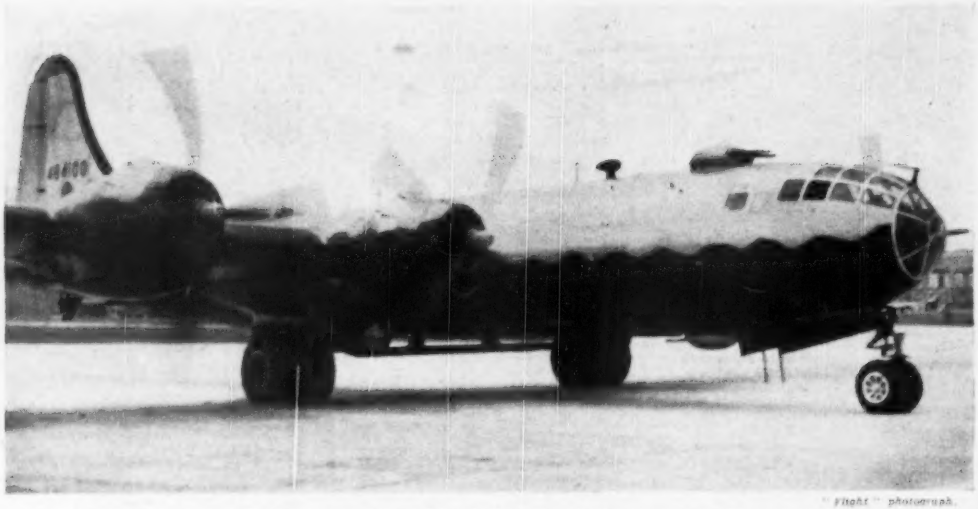
In 1936 came the Short C-class boats, 29 of which were ordered off the drawing-board for Imperial Airways. Their span was 112ft and from them have been developed the Sunderlands, Sandringhams and Solents.

The Short Shetland, with a span of 150ft, was successfully flown in 1945. If an order had been placed for 50 of them before the war ended, they could have been converted for passenger use, and might have put B.O.A.C. in the lead, and flying-boats as real rivals to landplanes.

Coming up to really recent times, in November, 1947, the Howard Hughes Hercules, a huge wooden flying-boat with a span of 320ft, made a short flight. Hughes was able to take it to a height of about 100ft for a mile or so as he had unlimited water space before him to put it down if all were not well. The fact that we have heard little more of it since then suggests that all was not well!

And now we await the prototype flights of the Saunders-Roe Princess, of 220ft wing span and ten tons heavier than the Brabazon. The first flight is expected next year. Will there come a day when we and our descendants look back on her as an aircraft of the medium-size class?

It is the author's view that the Shetland (150ft span), here seen with civil markings, should have gone into airline service.



"Flight" photograph.

A visiting Boeing Superfortress, finished with standard U.S.A.F. night-black on the lower surfaces. The small "wing" houses radar gear. This view also shows to advantage the cowlings of the Wright R-3350 18-cylinder radial engines, each rated at 2,500 h.p.

SUPERFORTS for BRITAIN

A Round-up of Essential Information on the Boeing B-29, Soon to Equip R.A.F. Bomber Squadrons : Possibility of Flight Refuelling

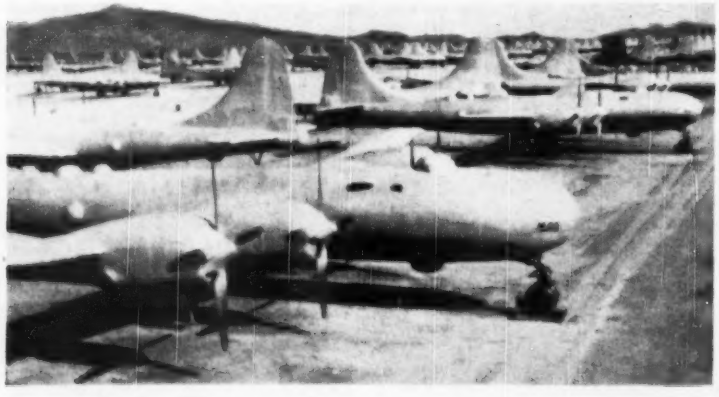
MONTH after month, rumour and counter-rumour concerning the supply to Great Britain of surplus American Superfortress bombers have besprinkled the pages of the daily Press. At length, on January 27th, came the official announcement that, under the bilateral Anglo-American arms agreement signed in Washington on that date, the R.A.F. will receive an initial quantity of seventy B-29s, with spares and equipment. The first reaction was one of gratification, for Bomber Command is sorely in need of a type of bomber to bridge the dangerous gap interposed between the Avro Lincoln and jet prototypes now under construction.

At the same time, there is a feeling of regret that, despite a thriving aircraft industry, our nation should have to accept such aid, even though it comes from friends, the merits of whose products we have come to appreciate.

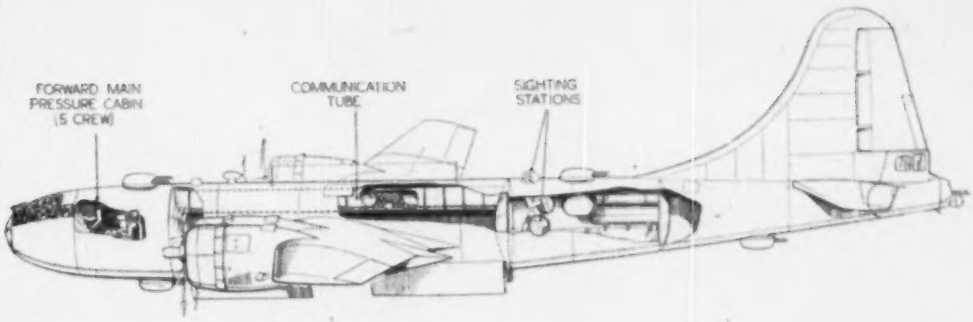
It must be recognized that, although superior to the unpressurized Avro Lincoln in speed, ceiling and range, the B-29 is already regarded by the U.S.A.F. as an obsolescent type, though it has been given a new lease of life—both as "receiver" and "tanker"—by flight refuelling. The latest development, now in service in considerable quantities, differs to such a degree that a new type-number, (B-50) has been allocated. As proved during air exercises over this country last year, the performance of the B-50 is greatly superior to that of the earlier model.

The design of the B-29 dates from early 1940, and the first prototype flew during September, 1942. After the war production was tapered off and ceased in May, 1946, whereupon some hundreds—each worth some £190,000—were "cocooned" in air-tight plastic.

The mid wing of the B-29 has an aspect ratio of 11.4 and is of the efficient Boeing 117 section. It has a butt-jointed skin with flush riveting, and electrically-operated flaps, which increase the area by nearly 20 per cent. The fuselage is largely of circular section and is built in five main portions. All three units of the nose-wheel undercarriage have dual wheels and are retracted electrically.



Some of 1,500 B-29's "cocooned" in air-tight plastic at Warner-Robins Field, Georgia. The covering is expected to maintain the aircraft in good condition for five to ten years.



A *Flight* copyright study of the internal arrangements of a typical B-29. Recently modified aircraft have provision for flight refuelling.

Various sub-types of the Wright R-3350 18-cylinder radial engine have been installed, but a typical nominal rating is 2,500 h.p. Each engine has two General Electric turbo-superchargers, disposed one on each side of the nacelle; the airscrews are Hamilton-Standard four-blade Hydromatics of 16ft 7in diameter. Integral with the wing structure are self-sealing fuel tanks, with a total capacity of 4,647 gallons, but a large number of B-29s have already been modified for flight refuelling. Both the British technique and a Boeing system—the latter making use of a rigid boom—have been tested in America.

There are various armament schemes, but typically the B-29 is provided with four General Electric remotely-controlled barbettes, two above the fuselage and two below. The later aircraft have four 0.5in guns in the forward upper barbette and twin guns of the same type in the rear upper and the two lower barbettes. The tail gun position likewise has twin 0.5in guns and is of Bell design. There is one sighting station in the nose; three in the main pressurized compartment, and one in the pressurized tail-compartment. Although arrangements are made so that only one sight can control a given barbette at one time, selected sighting stations are provided with secondary control over other barbettes.

The total bomb-load is 20,000lb, stowed in two cells, one forward and one aft of the central wing structure, where this passes through the fuselage. Some machines are modified to carry a 20,000-lb bomb semi-externally. The bomb doors are electrically operated.

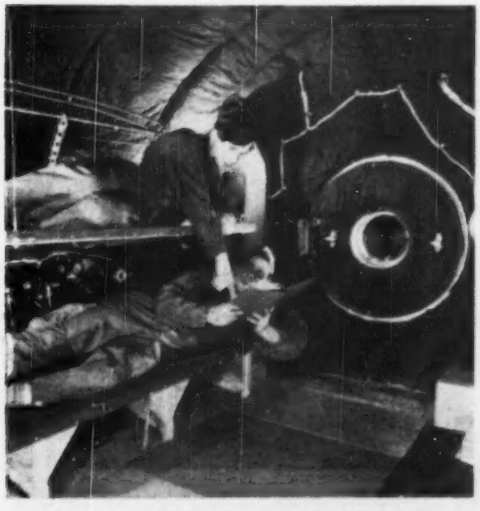
Members of the staff of *Flight* who have flown in B-29s report very favourably on the type. The insulation of the pressure cabins is effective in reducing heat absorption on hot days, and likewise affords protection against the cold and—equally important—engine noise. The bomb-aimer's position in the nose is very liberally provided with transparent panelling. Pilot and co-pilot are immediately behind, with their seats somewhat raised to afford uninterrupted vision over the bomb-aimer's head. Behind the co-pilot, on the starboard side, is the flight engineer; the navigator is behind the pilot, and the sixth occupant of the control cabin—the radio operator—is positioned aft of the flight engineer's instrument panel, next to the pressure bulkhead separating the cabin from the bomb-bay section.

Taking the Tube

Connecting the two pressure cabins is a 35-ft tube running over the bomb bays and of sufficient diameter to serve as a crawlway. It is, of course, pressurized to the same degree as the two cabins. The sensation of looking down the tube is akin to that of peering into the wrong end of a telescope; at the far end, the pedestal seat for the rear upper gunner may be perceived.

Immediately to the rear of this main fire-control section are the crew's quarters, where there are folding bunks for those off duty. The rear wall of the compartment is the pressure bulkhead, aft of which—in the unpressurized tail section—is the auxiliary power plant and other equipment. There is room to stand erect in the pressurized tail-gun position, and the seat is comfortable.

Although never operational over Europe during the late war, B-29s were well tried in the Pacific theatre and were, of course, used to drop the atomic bombs on Hiroshima and Nagasaki. The type is further interesting in that its design has been closely imitated in the Tupolev bomber (possibly designated Tu-170), which now arms strategic bomber units of the Soviet Air Force.



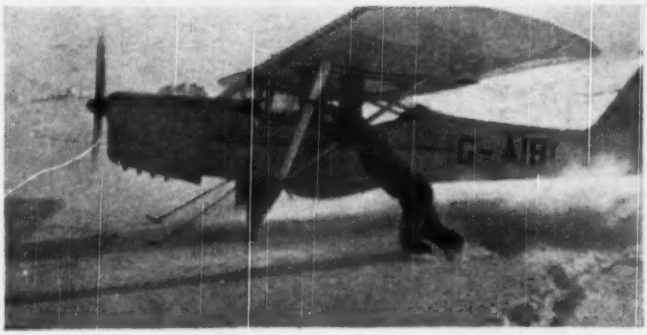
At the rear of the second pressurized compartment B-29 crew members off-duty may take their rest in these bunks.

BOEING B-29 DATA

(Four Wright R-3350 18-cylinder engines of 2,500 h.p.)

Dimensions	
Span	141ft 3in
Length	99ft
Height (over tail)	27ft 9in
Wing area	1,739 sq ft
Weights	
Empty weight	74,500 lb
Gross weight	120,000-140,000 lb
Wing loading	80 lb/sq ft
Power loading	15.8 lb/h.p.
Performance	
Maximum speed	350 m.p.h. at 24,500ft
Climb to 25,000ft	44 min
Range (max. continuous cruising power)	2,850 miles at 10,000ft

HERE and THERE



SLIPSTREAM AND SNOW: Taxying out the ski-shod Auster which accompanied the original Graham Land expedition in 1947, members of which are now being evacuated by air (as reported below) from icebound Stonington Island, Marguerite Bay.

Bristol History

THIS year the Bristol Aeroplane Co., Ltd., celebrates its fortieth anniversary, and in next week's (February 16th) issue of *Flight* will appear a photogravure supplement dealing with the famous aircraft built by the firm.

Trans-Canada Record

A NORTH STAR of No. 426 Transport Squadron, R.C.A., recently cut seven minutes from the two-year-old trans-Canada record, by flying from Vancouver to Halifax in 8 hr 25 min (485 m.p.h.). The pilot was F/O. Gordon Webb, D.C.M. and bar. There was a tail-wind, sometimes exceeding 100 m.p.h., but the speed is nevertheless very creditable.

Expensive Scoop

ALLEGED to have flown over the manœuvring area of the airfield at Filton at less than 500ft, in order to allow a Press photographer to obtain pictures of the Brabazon, the pilot of an Auster was recently fined £10 at Staple Hill (Bristol) Magistrates' Court. The proprietors of the journal concerned were fined £60 and two employees £10 each.

Antarctic Rescue

ON January 30th the first two of the five British scientists who have been marooned by heavy sea-ice on Stonington Island, in Marguerite Bay, Graham Land, for more than three years, were brought out by air. The Norduyn Norseman carried by the supply-ship *John Biscoe* made the relief-flight from the base established on Argentine Islands, 200 miles distant, with Peter St. Louis, a Canadian, as pilot; it was achieved without incident, though floating ice added to the difficulty of the take-off from a fiord at Stonington Island, and base was reached just as a thick mist closed in. In addition to the five scientists mentioned, there are six others who have been there for two years.

The *John Biscoe* also carries an Auster floatplane, used for reconnoitring routes through the ice. An Auster—seen in the photograph on this page—accompanied the original exploration party in 1947, but crashed during a survey flight; the crew made a ten-day trek back.

U.S.A.F. General for London

THE appointment of Maj. Gen. Leon Johnson, U.S.A.F., to the American Embassy in London for duties in connection with the mutual defence assistance programme, was announced last week by the U.S. Secretary of Defence, Mr. Louis Johnson.

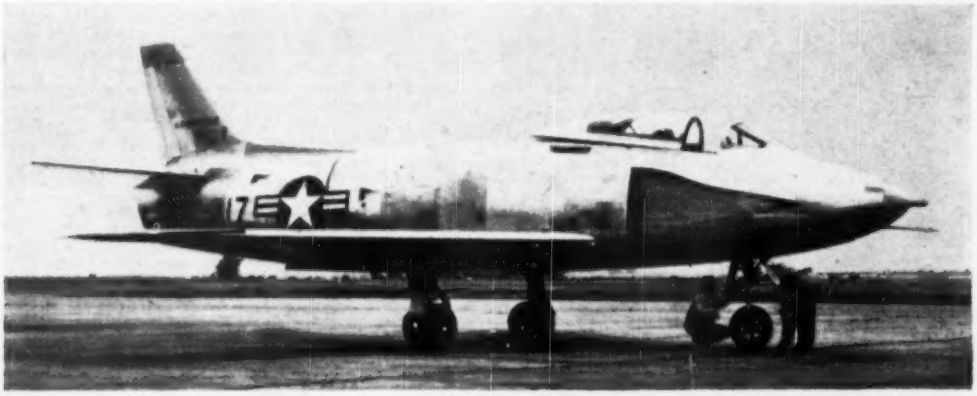
Maj. Gen. Leon Johnson, who commanded a heavy bomber group in the European theatre during the war, is one of seven American flag and general officers designated as chiefs of the Military Assistance Advisory Group. The others are appointed to Brussels, The Hague, Rome, Copenhagen, Oslo and Paris.

B.A.L.P.A.'s New Chairman

LAST week Capt. A. le R. S. Upton was elected chairman of the British Airline Pilots' Association for 1950, in succession to Capt. A. P. W. Cane. After leaving the R.A.F. in 1932, he flew for various airlines until he joined Imperial Airways in 1936. Much of his war-time flying was on the "horse-shoe route" in Africa, and for the past three years he has been employed on flying-boat training.

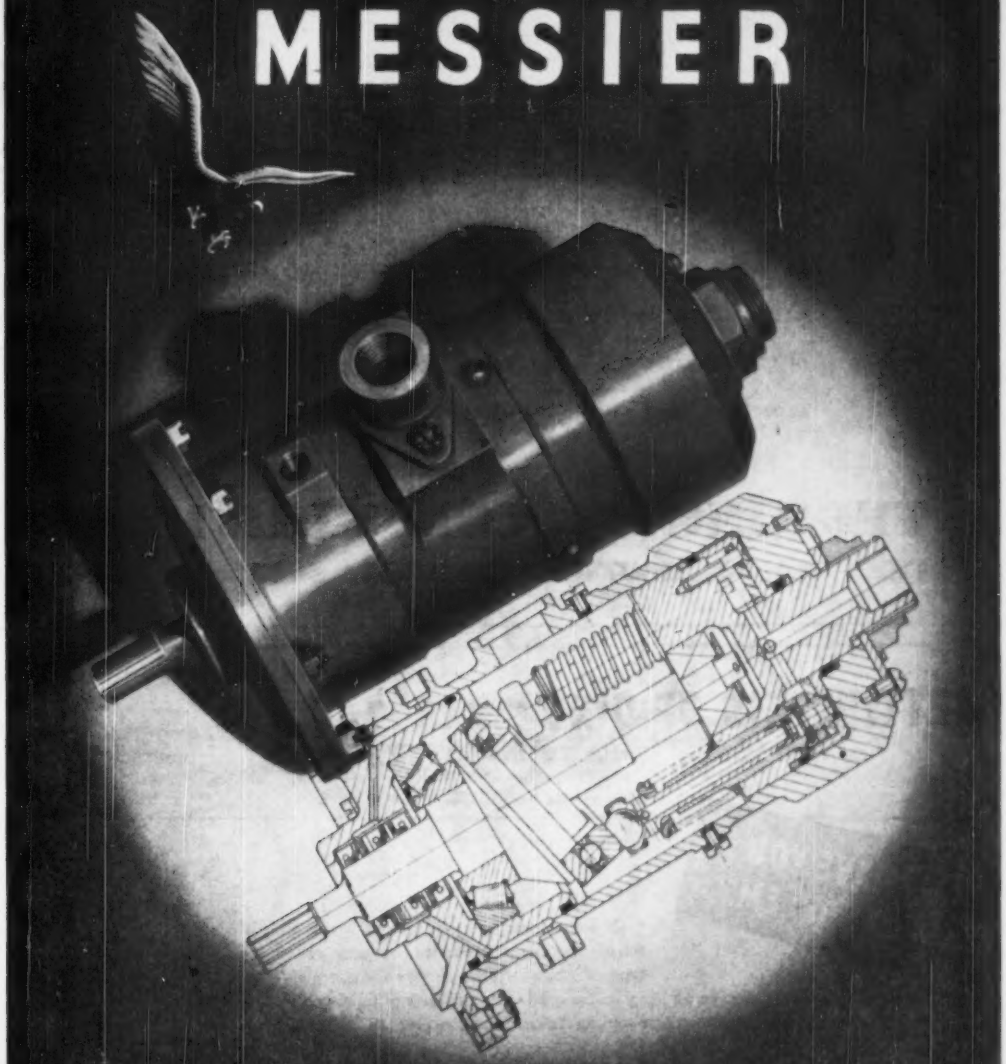
Belgium and R.A.F. Orphans

FOLLOWING the visit of 150 R.A.F. orphans to Belgium, the Chief of the Belgian Air Staff, General L. Leboutte, has sent a message to the R.A.F. Benevolent Fund, who organized the visit with the assistance of the International Help for Children. He said that Belgian families who entertained the children to a month's holiday in their own homes were glad to show that Britain's war-



PENETRATIVE: Last week, in "American Notebook," *Flight* published an appreciation of the YF-86D development of the North American F-86 Sabre. The still newer machine now depicted—likewise a member of the Sabre family—differs so extensively as to warrant redesignation as YF-93. Noticeable features include flush intakes to the Pratt and Whitney Tay (Rolls-Royce licence) turbojet with afterburner, and a new undercarriage with dual main wheels. New armament may also have been embodied.

MESSIER



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HERE AND THERE . . .

time sacrifices still lived in the hearts of the Belgian people.

It is hoped that a further similar visit will be arranged next summer and that the party will again include boys from the R.A.F. Benevolent Fund's own school at Vanbrugh Castle, Blackheath.

Warned Off

CONTROLLED areas of 100 miles' radius have been established round the major atomic production centres of the United States, together with a 100-mile-deep zone along the coast from Norfolk to Maine. Special flight-plans must be filed, and aircraft violating the new rules may find themselves intercepted by U.S.A.F. fighters.

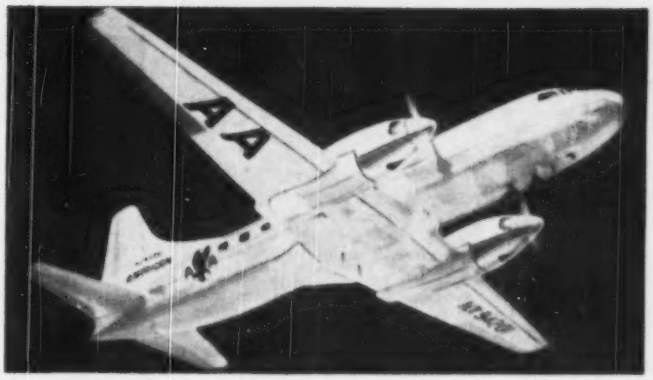
Reward for Efficiency

THE winner of the Women's Junior Air Corps "Flight to Australia" competition, chosen from seven finalists by a selection board in London, is Unit Cdr. Doreen Pennell. Candidates, who had to have exceptionally good records of service, were required to write a number of essays, including one on the future of civil aviation. Miss Pennell, who is top-marker in W.J.A.C. Link trainer instruction at Birmingham, will be rewarded by a B.O.A.C. flight to Australia on March 9th.

Stratospheric Thought-reading

LISTENERS to B.B.C. programmes last week heard the most remarkable of the Piddingtons' thought-reading broadcasts, when Mrs. Piddington, in a B.O.A.C. Stratocruiser on a training flight over the west of England, accurately repeated (over the aircraft R/T. system) thoughts "transmitted" by her husband in a London studio.

Capt. W. S. ("Bill") May, the Corporation's C.F.I. at Filton, left the flight deck during the broadcast to say a few appropriate words to listeners. Incidentally, clarity of speech was easily the best we have ever heard from an aircraft in the air; modulation was perfect, and the only background noise was the gentle rumble of the four Wasp Majors.



TURBOPROPOSITION : Some time ago it was suggested that the Convairliner would be suitable in many ways to take turboprop power units. The suggestion is now being seriously considered, with two Allison T-38 turboprops in mind. The illustration shows how *Aviation Week*'s artist thinks it might look. Incidentally, Convair produced the first American turboprop installation, the XP-81 (TG-100 in the nose, I-40 in the tail).

NEWS IN BRIEF

THE R.A.F. has disbanded its flight of falcons, formed experimentally to clear airfields of other birds.

* * *

This year's R.Ae.S. garden party is again to be held at White Waltham, by permission of the Ministry of Supply and the Fairey Aviation Co., Ltd. Sunday, May 14th, is the date.

* * *

Capt. David Barclay, M.B.E., commander of B.E.A.'s ambulance flight, has been admitted by His Majesty the King as a Serving Brother of the Order of St. John.

* * *

In appreciation of hospitality shown by the airport commandant and his staff during the visit paid by the Belfast Branch of the R.Ae.S. to Nutts Corner, the committee has endowed a tree. It was planted recently in the garden area of the airport by th R.Ae.S. Branch chairman, Rear Admiral Slattery.

Mr. Alex Fraser, vice-chairman of Girling, Ltd., left England on January 26th for a month's business tour of South Africa in connection with the servicing of Girling products.

* * *

Mr. A. D. Young, M.A., A.F.R.Ae.S., has been appointed to succeed Prof. W. J. Duncan to the Chair of Aerodynamics at the College of Aeronautics. He was formerly at the R.A.E.

* * *

The Aircraft Golfing Society is to hold a dinner-dance at the Hyde Park Hotel, London, on Friday, April 28th. Tickets (30s) from the hon. secretary, Mr. Brian D. Songhurst, 55b, Woodville Gardens, London, W.5.

* * *

Plioflim, produced by the Goodyear Tyre and Rubber Co. at Wolverhampton, is now being used in the preparation of Fibreglass blankets for aircraft-interior soundproofing. The Plioflim outer "skin" acts as an efficient moisture-proof container.

* * *

Ashdowns, Ltd., Knowsley Road, St. Helens, Lancs, announce that they are now in a position to meet American specifications for glass-cloth and glass-cloth/cotton-cloth laminates for aircraft ducting, wall and floor linings, and other applications.

* * *

Adhesive packaging-tape is extensively used in the despatch of spare parts, and firms handling work of this kind will be interested in the new high-speed automatic tape-dispenser marketed by John Gosheron and Co., Ltd., Gayford Road, London, W.12. It delivers cellulose or paper tapes accurately to predetermined lengths.

* * *

Formed by a body of engineers for the purpose of organizing visits by British members to factories abroad, the Engineers' Educational Travel Club (Westminster), Ltd., has already arranged visits, to take place this year, to Italy, Norway, France, Switzerland, Belgium and the U.S.A. Details are obtainable from the secretary, at 35, St. George's Square, London, S.W.1.

THREE IN HARMONY : Differing only in mark (and possibly Mach) number, and in colouring, these three Gloster Meteors were recently seen at their makers' airfield at Moreton Valence—a Mk. 8 for the R.A.F. and "Fours" for Denmark and Egypt.

AMERICAN NOTEBOOK

By

Stanley H. Evans

F.R.Ae.S., A.F.I.Ae.S

"GEE" WHIZ

ACCORDING to a recent paragraph in *Time*, one of America's leading economic oracles, Roger Babson, has set up a Research Foundation which will try to find a way of eliminating, or at any rate cushioning, the effect of gravity. Anyway, Babson (who has made a mint of real money prophesying the wave motions of the boom-and-bust trade) is reported to be needling in the research haystack for an "anti-gravity screen" that will insulate heavy objects from the malicious pull of *g*. Apparently the idea is to make *homo sapiens* and his diabolical inventions (such as aircraft and atom bombs) weightless at will. We know dozens of aircraft weight analysts who would pay a nice sum for this kind of pull-preventing pill.

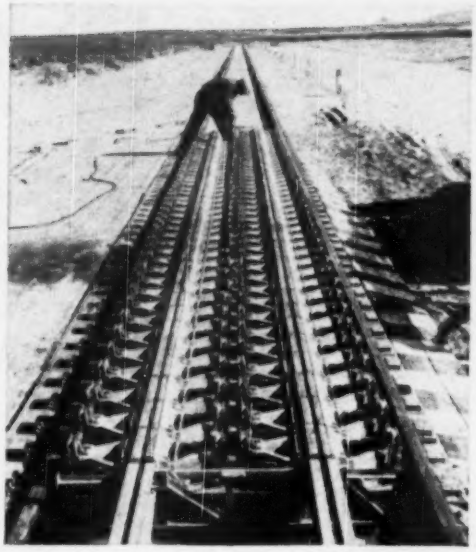
Unhappily, a little more reflection leads one to believe that it would set the aircraft industry back quite a few years, since the stress and aerodynamic chaps would have to go back to school to rearrange their old-fashioned ideas of Newtonian mechanics.

In the meantime, however, if we cannot fend off the attractive wiles of Mistress Gee, we can at least do something to tame the affections of this constant (more or less) nymph. That, in fact, is what our engineering friends at Northrop have been up to for the past couple of years, in co-operation with the physiological research branch of the U.S.A.F. at Muroc. Under a research project aptly described as the "Dynamic Stress Analysis of the Human Body," Northrop have developed an interesting mechanism, known as an aircrew decelerator, for simulating the effects of rapid deceleration in aircraft crashes; or, to be more scientific and more specific, the purpose of this research was twofold, namely: (1) to determine the tolerances of the human body's resistance to decelerative forces; and (2) to develop and test equipment for protecting crews and passengers involved in crash landings and ditchings.

To date, some 47 test runs have been performed with human volunteers, 14 of which reached linear decelerations of between 30 and 35 *g*. A peak *g* of 57 has actually been recorded for a split second with a human subject strapped in a rearward-facing seat—which goes to show the astonishingly high modulus of elasticity of the human body when taking it on the dorsal instead of the chin. Clearly, when *genus homo* can be compressed between a four-ton mattress over a minute time-interval "dt," he isn't doing too badly after all this long absence from swinging in the treetops.

A look at the accompanying illustrations (or at one which appeared in *Flight* of January 19th, p. 69) will show the Northrop Aircrew Decelerator to be a rocket-propelled rail car mounted on metal slippers in lieu of wheels. The carriage framework is built of welded aircraft tubing, weighs 1,500 lb, and is stressed for an ultimate load factor of 150; i.e., 100 *g*, plus a 50 per cent safety margin. Overall dimensions of the chassis are 178in x 80in x 74in. Running lengthwise under the chassis are two armour-plate braking rails, or vertical blades, measuring 134in x 5in x ½in, which are engaged by the ground braking system when the carriage is being decelerated during a test run. Propulsion is supplied by four 5,000 lb/sec solid fuel rockets designed to deliver, within accurate limits, an individual thrust of 1,000 lb for 5 sec. (The number of rockets fired varies according to the test requirements.)

In the first tests the "subject body" and test instruments were protected by an enclosed cab of riveted light-alloy construction mounted atop the carriage, but most of the later tests have been run with only the sloping windshield depicted in the illustrations. Apropos which, Major John P. Stapp, the U.S.A.F. aero-medical research scientist in charge of these Muroc experiments, was the first live body to make a test run and at the time of writing holds the top score with 19 runs, 5 of which exceeded 30 *g*.



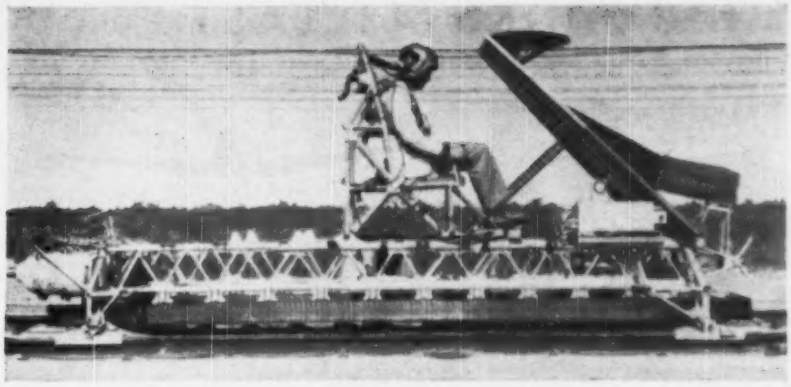
Braking section of the rail track: it contains 45 sets of brake mechanisms, each comprising right-and left-hand hydraulically-actuated clasp-type brake shoes. Any combination of the 45 sets can be used. The section could halt the equivalent of a 3,000 lb, 100 m.p.h. automobile in less than 3 feet.

So much for the dynamic aspect. The static side of the set-up consists of a rail track 2,000 feet long, with a braking area between the rails extending over about 50 feet and beginning at a point 1,250 feet from the starting end. The braking system comprises 45 individual brake units, each unit consisting of two pairs of clasp-type brake shoes installed transversely in the road-bed. These brake pairs are aligned in two parallel ranks between the rails, forming a pair of length-wise slots through which the braking rails (or keels) of the carriage slide. When the carriage enters the braking section, the retarding action is built up by successive brake pairs clasping the rails of the carriage.

The brake shoes are made of special soft iron moulded on steel webbing. Hydraulically actuated at a pressure of 600 lb/sq in, each shoe is capable of exerting a braking force of 33,000 lb. (There are 180 separate brake shoes, each with a braking area of 55 sq in.) Each of the 45 brake units may be controlled individually to provide any desired variation in braking force. Construction of the brake units required considerable pioneering by Northrop in a comparatively old field and the know-how of the American Brake Shoe Co. was enlisted in the development of the shoe material. The original shoes are still *in situ*.

By varying the number and pattern of the brake sets and the firing combination of the rocket battery it is possible to produce controlled decelerations from 5 to 50 *g*. The maximum velocity of the carriage as it enters the braking section can be as high as 240 m.p.h., although the majority of the runs to date have been of the order of 150 m.p.h. A deceleration of 35 *g* is accomplished by retarding the carriage and rider from 150 to 75 m.p.h. in a time interval of 0.16 sec. The velocity curve for a typical six-brake run is illustrated.

An emergency braking system is installed near the extreme end of the track. It consists of a flexible steel cable stretched across the track at right angles, each end

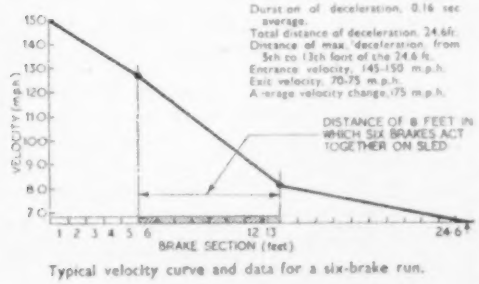


The Northrop aircrew decelerator with U.S.A.F. volunteer "subject body" ready for a forward-facing test run. Note the four solid-fuel rocket flagons at the rear; the disc at the upper edge of windshield, supporting a tiny telemeter antenna; and the longitudinal brake blades at the bottom of the chassis.

of the cable being wound on hydraulically-loaded reels or drums. Whenever the carriage enters the emergency area a hook on the front of it engages the cable and the tension applied to the cable through the hydraulic braking reels brings the carriage to a halt. The principle, of course, will be recognized as an established naval custom, although happily the vertical bounce is absent. (Incidentally, we gathered from the volunteer subject-bodies that this is easily the favourite part of the run!)

The instrumentation side of this project must also be counted as a major contribution by the Northrop engineering team. To obtain scientific data from the runs it was necessary to devise a means of transmitting information during the brief period available—which is where the electronic experts take over from the mechanical gadgeteers. What is considered to be a unique miniature radio-transmitter was designed, capable of sending four simultaneous signals and mounted in a special cushioning element which enables it to function even while subjected to the enormous shock as the carriage enters the brakes. In fact, one has to witness this remarkable pull-up performance to understand fully what it really means, both to the human subject and the recording apparatus. (With adequate braking power, a stout harness—and a *very* stout stomach—you can try it for yourself by driving a car at 75 m.p.h. and stopping flat in 9 feet.)

At present, four accelerometers are mounted within the carriage, attached either to the occupant or the chassis. Data from these instruments are transmitted through shock-proof telemetering equipment to a control tower some distance from the track. Signals generated by strain gauges attached to various parts of the subject-body and harness can be similarly recorded. Provision is also made for mounting automatic movie-type cameras inside the carriage in forward, aft or profile positions, and in this manner a close-up photographic record is obtained of the reactions of the volunteer sled-rider. A study of the latter in conjunction with the strain-gauge data should prove invaluable in the design of seats and safety harness.



Typical velocity curve and data for a six-brake run.

Timing of the test runs is performed by a Northrop-developed space-time recording system comprising coils mounted at 25ft intervals along the track, except in the braking area, where the intervals are reduced to 1ft. A magnet attached to the carriage actuates each coil as it passes over it, flashing a series of lights in the control room. Light flashes recorded by a high-speed camera provide a permanent record.

So far these tests have shown that the human body can withstand without injury a linear decelerative force of 35 *g* when facing in either the forward or backward positions. (This linear *g*, by the way, should not be confused with the radial *g* produced by high-speed manœuvring. In the seated position, the limiting radial *g* before blacking-out is of the order of 6-8, but this can be raised to about 12 in the prone position.) The Northrop research confirms the well-known fact that the safety potential of the backward facing seat is higher than the more usual forward-facing arrangement. Thus, in tests with the normal seating it was necessary to provide the occupant with a special seat harness consisting of web straps fastened across the lap, around each thigh, and over each shoulder to enable him to withstand the combination of high forward ejection force and unequal pressure-distribution. In the backward position, of course, the back of the seat provides the main support and distributes the pressure more uniformly, and hence the ordinary seat-type safety belt is sufficient.

Application of this aero-medical research data to the design of future aircraft furnishings may be expected to increase materially the chances of survival in crash landings. Major Stapp's thesis is a rational one, we think. It really boils down to giving the passenger a chance to walk away from his accident before the fire brigade arrives. Anyway, until Babson comes through with *his* answer, we can at least mitigate the magnetic effect of Miss Gee by turning our backs to her.

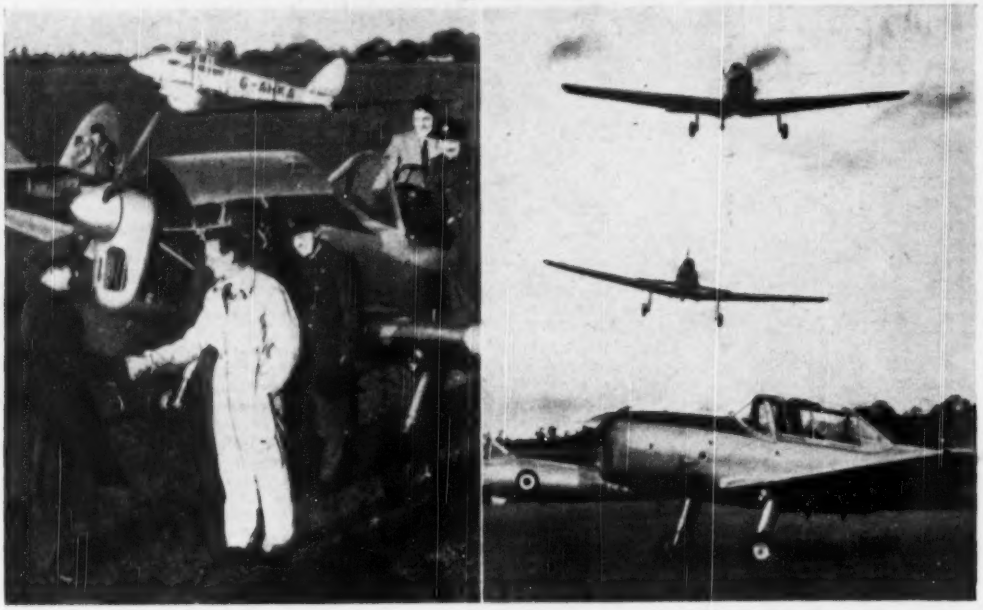
TWELVE-SEAT SIKORSKY

FURTHER details are now available of the Sikorsky 12-seat H-19 helicopter, which made its first flight late last year. Apart from its comparatively large size, the newcomer (a photograph of which appeared in *Flight* of December 15th, 1949) is chiefly notable for the unusual mounting of the 600 h.p. Pratt and Whitney Wasp, which is inclined at an angle of about 45 deg in the nose, and is directly accessible through clamshell doors.

The two-seat pilots' compartment is above and forward of the 363 cu ft main cabin, and there is a communicating hatch. For ambulance work, the cabin can accommodate up to eight stretchers, which can be power-hoisted while the machine is hovering.

Construction is of metal throughout, and a wide-track four-wheel undercarriage is fitted. Full-load range is 280 miles, cruising speed 85 m.p.h. and top speed—as indicated by early tests—comfortably over 100 m.p.h. No dimensions are yet available. A commercial version, designated S-55, is planned.

CHIPMUNKS AT LAST



Fortunate recipients of the first batch of de Havilland Chipmunks to be delivered to a training unit are pilots of the Oxford University Air Squadron. Flying in very rough weather—to which the Chipmunk takes more kindly than does the Tiger Moth—six of the new trainers were delivered to Kidlington from Hatfield on Friday, February 3rd, Mr. Pat Fillingham, D.H. test pilot, leading the flight. The six aircraft were officially accepted by W.C. Foxley Norris, commanding officer of the O.U.A.S. (the photograph, left, shows him shaking hands with Pat Fillingham), and there was a fly past and an aerobatic display by Mr. Fillingham. All university and V.R. squadrons are to receive Chipmunks during the next few months.

PRODUCING A PROTOTYPE

THIS evening (February 9th), at 6 p.m., Mr. C. T. Wilkins, A.F.R.Ae.S., assistant chief designer of the de Havilland Aircraft Co., Ltd., will read a paper before the Royal Aeronautical Society, at the Institution of Civil Engineers, Great George Street, London. His subject will be "The producing of a prototype aircraft."

Starting from the point where the general arrangement of the aircraft has been drawn, he will describe what, in his opinion, should be the best way to produce the aircraft in the shortest possible time and at the least possible cost. Mr. Wilkins will point out that, broadly speaking, there are two kinds of prototypes: the research aircraft from which to obtain specific data for a future production type, and the first aircraft of a production order. Too many machines, he believes, are built first as one or two prototypes, a process taking two years or more, and then being followed, perhaps, by another year of test flying, then by another period of two years before the first production aircraft is delivered. Following this, still another year may be spent in proving flights before the aircraft reaches operational service, and thus as much as six years may elapse from the time when the prototype is started until the aircraft goes into operational use.

GOOD PARTY IN GOOD CAUSE

A BALL held at the Dorchester Hotel, London, last Friday should substantially benefit two organizations. The R.A.F. Benevolent Fund, which it is expected, may receive something not far short of £1,000; and the sponsors, the R.A.F. Reserves Club, who undoubtedly made many new friends and whose membership should benefit accordingly.

Among the guests of honour was Lady MacRobert, whose generous financial contributions towards the fighting strength of the R.A.F. during the war—made in memory of the three sons she lost—are not forgotten. She was introduced during the evening by Air Chief Marshal Sir Guy Garrod.

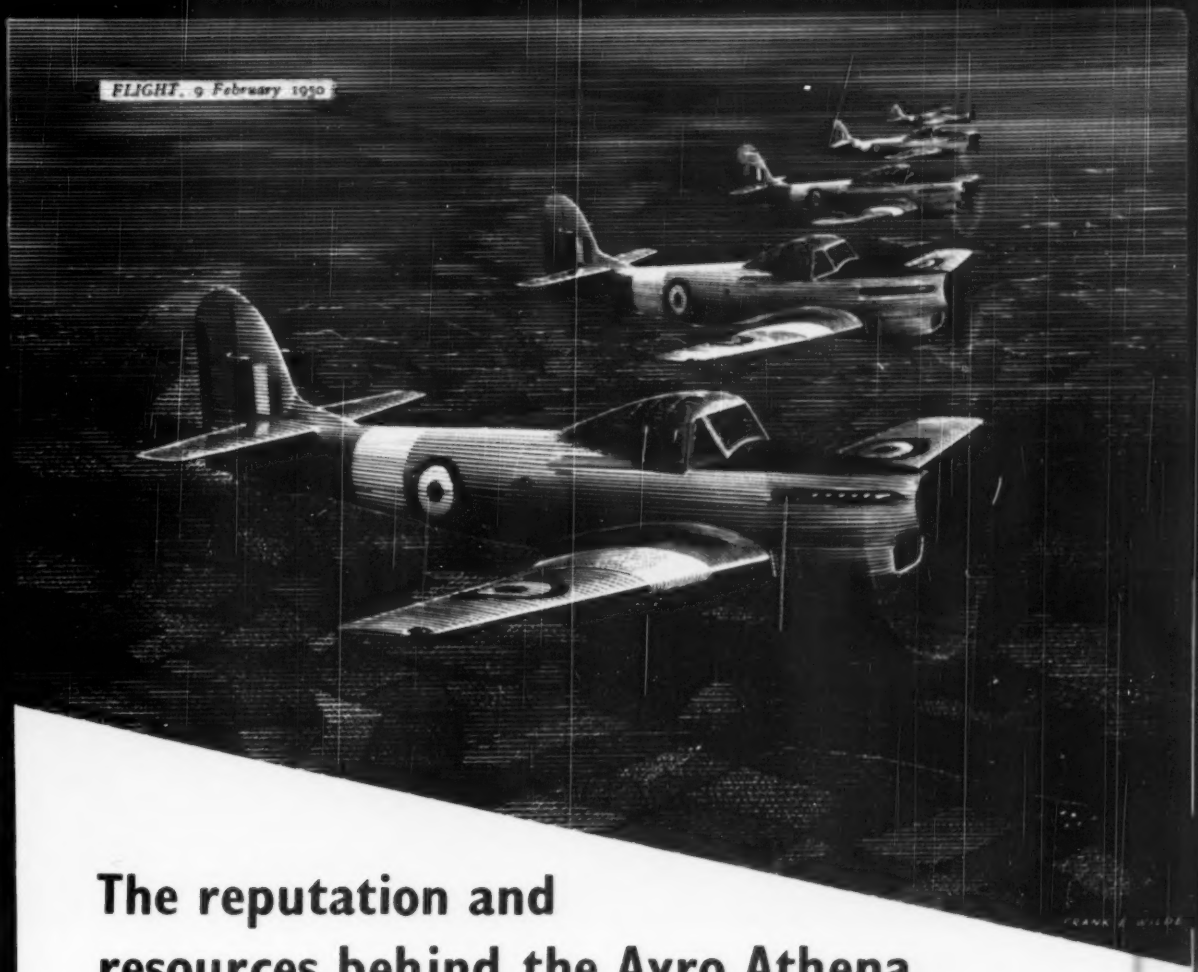
"Bomber Command," "Coastal Command Ops," "R.A.F. Escaping Society," "Radar," "Pathfinders"—these and a dozen other notices on tables showed how truly this was a reunion of past and present Service people; the Industry, too—particularly Hawker-Siddeley and Rolls-Royce—was well represented.

On the entertainment side, Professor Jimmy Edwards (who has a D.F.C.) "took it from here" in his inimitable style, raising not only loud laughs but prodigious sums of money by auctioning various comestibles and wearables, for which one of the most sporting bidders was Gen. John B. Ackerman, the U.S. Air Attaché.

Altogether one of the better parties, on which the youthful R.A.F. Reserves Club—it was formed only two years ago—deserves congratulation. Incidentally, past and present Service people who are looking out for a social and residential West End club with truly modest membership fees should investigate this one, whose H.Q. are c/o the R.N.V.R. Club, 38, Hill Street, London, W.1.

FORTHCOMING EVENTS

Feb.	9.	R.Ae.S.: "Producing a Prototype Aircraft," by C. T. Wilkins, A.F.R.Ae.S.
Feb.	14.	R.Ae.S. Section Lecture: "Prototype Testing," by D. R. H. Dickinson, A.F.R.Ae.S.
Feb.	17.	Institute of Navigation: "Air Traffic Control," a symposium of papers.
Feb.	21.	R.Ae.S. (Belfast): "Strength-testing of Aircraft," by Dr. P. B. Walker, M.A., Ph.D., F.R.Ae.S.
Feb.	21.	R.Ae.S. Section Lecture: "Air-intake Design for High-speed Aircraft," by Dr. J. Seddon, B.Sc.
Feb.	22.	R.Ae.S. (Preston): "Radar and the Aircraft which Use it," by B. W. Hodlin, B.Sc.
Feb.	22.	R.Ae.S. (Reading): "Propeller Turbines," by A. C. Clinton, F.R.Ae.S.
Feb.	23.	R.Ae.S. Graduates: "Problems of Heat Transfer," by W. R. Shapey, B.Sc., Grad. R.Ae.S., and J. Rivers, Grad. R.Ae.S.



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Details of the Hawker Swept-wing Experimental Fighter for High-speed Research

ALTHOUGH it is now fifteen years since sweep-back as a means of reducing drag at high flight speeds was proposed—by Busemann at the fifth Volta Conference in Rome—the physical advent of aircraft designed aerodynamically on the basis of Busemann's theory is a comparatively recent occurrence. There was, of course, not a great deal of practical point in the theory in 1935, for it was not until jet- and rocket-propulsion lifted speed-potential into sonic realms that the pros and cons of sweep-back could be, or indeed needed to be, factually determined.

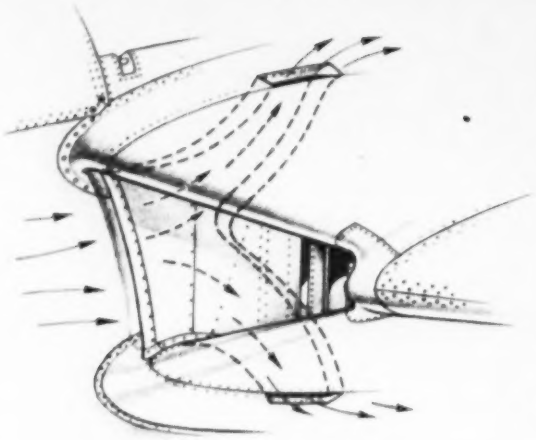
Curiously, although the Germans were the first to put Busemann's ideas to the test, our own aerodynamicists were also concentrating on the problems of drag reduction at high speed and, recollecting the Volta Conference, brought the Busemann paper out of its pigeonhole, dusted it, and re-examined the reasoning and conclusions. Later on, when the war had finished, a good deal of the German data became available and our field of knowledge on the subject was materially increased. It is, nevertheless, still true to say that, even to-day, there is much to be learned about the aerodynamics of swept wings.

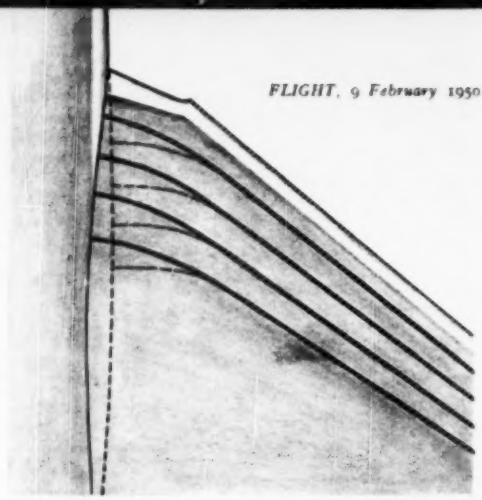
The Hawker design team, under Sydney Camm, first started concerning themselves with sweep-back in 1945, when a design was conceived for a development of the P.1040 employing swept-back wings. This was the genesis of what was later to become known as the P.1052. In the first instance, however, no official interest was manifested and, in fact, was not forthcoming until spring of the following year. The design thereupon submitted was the first to carry the designation P.1052 and a few months later Hawker Aircraft, Ltd., received official instructions to proceed with design and construction. This was followed by contracts for two aircraft (in May, 1947), and although the first machine to be built—VX272—was ready in time for static exhibition at the S.B.A.C. Farnborough display in 1948, permission was withheld on the grounds of secrecy. The first flight of the 1052 was made on November 19th, 1948, with Trevor Wade, the companies' chief test pilot, at the controls.

Some few weeks ago (November 10th), *Flight* published a detailed analysis of the Sea Hawk, this being the name given to the Naval fighter into which the original P.1040 was developed. In that the swept-wing 1052 has a close affinity with the Sea Hawk, it is not unnatural that each type has a great deal in common with the other. In point of fact, the fuselage and power installation are virtually identical, the chief points of disparity being that the 1052 as a research aircraft is not fitted with guns or military equipment; the forward wing/fuselage mounting is different and, of course, the arrester hook so necessary for the Sea Hawk is not required by the 1052. Whilst on the subject of intrinsic differences, it may be mentioned that the undercarriage, although of similar geometry, is a shorter version of that used on the Sea Hawk and is, in fact, essentially that used on the P.1040. Again, the wing-root intakes are genetically the same, although the detail form is somewhat different; finally, the tailplane is of reduced span and is adjustable in incidence—we will, however, return to these aspects of the design later on.

There is not much point, we feel, in attempting to describe a swept-wing aircraft without making some definitive statement as to the reasons for having the wings swept back. This, unfortunately, is not something that is amenable to discussion in general terms, and in order to provide a clear picture of the theory supporting what is, after all, a matter of some complexity, it is necessary to resort to a little elementary mathematics. Thus, in the initial instance, the principle is made most readily understandable by considering a yawed wing of constant chord and infinite span, with the chord disposed at an angle ψ to the airflow. This will necessarily produce velocity components $V \cos \psi$ and $V \sin \psi$ along and normal to the wing chord, and in that the second of these components represents a constant spanwise velocity it has no bearing on the pressure distribution around the wing—aside, that is, from small skin friction effects.

It can therefore be reasoned that, in the shock stall case, the critical parameter is not Mach number M, but $M \cos \psi$. As a consequence, the coefficients of lift and drag at a





(Left) Detail of port intake, showing boundary-layer bleed. (Right) The effect of fuselage-waisting at wing intersection in straightening isobar endings. Dotted lines show the unwaisted condition.

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given value for M in the case of a conventional straight wing are changed when that wing is yawed at ψ to $C_L \cos^2\psi$ and $C_D \cos^3\psi$ at Mach number $\frac{M}{\cos\psi}$. The effect of sweep-back is, therefore, to increase (in the ratio of sec ψ : 1) the Mach number at which given compressibility reactions occur. It must, however, be emphasized that the effects summarized are idealized and, strictly, are therefore valid only for yawed wings of infinite span. In the far from ideal conditions of physical practice, the advantages to be gained by sweep-back are, perhaps, 50 per cent of those suggested by idealized theory. They are, nevertheless, very well worth while and, in the Hawker case, show a handsome profit in limiting speed as between the straight-wing and swept-wing versions of the aircraft.

The angle of sweep-back used for the 1052, namely, 35 deg at 0.25 chord, was an arbitrary choice decided upon as offering a reasonable compromise between the achievement of a useful reduction of drag at high speed, and the maintenance of good handling qualities at low speed without the use of slots. In the event the gain in speed has been marked, whilst, astonishingly, the handling characteristics at low speed are virtually as good as those obtained with a straight wing.

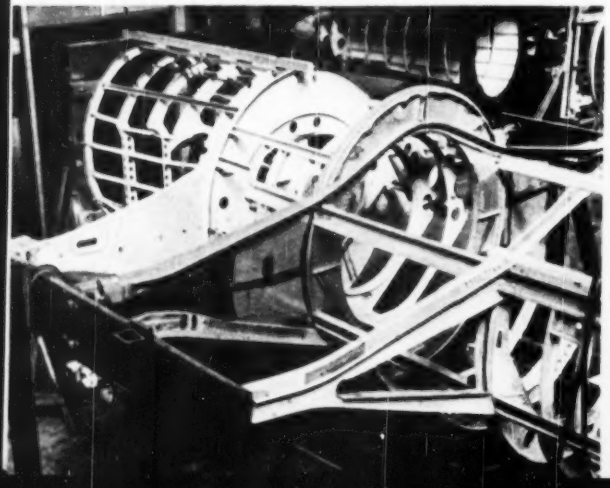
Aspect ratio was chosen in accordance with the results of an interesting study in which various aspect ratios were plotted against sweep-back for a whole family of wings. From these curves, a demarcation line could be drawn between optima and pessima and, as a result, the optimum aspect ratio for the particular angle of sweep-back selected for the 1052 was indicated—and it seems to work very well in practice.

As in the case of the Sea Hawk, the centre-section stub wings are, to all intents and purposes, integral with the fuselage, but in the 1052 the nominal span of the stub wings has been reduced. This was brought about by the desirability of increasing the area of the wing proper as much as was practicably possible. In order, however, to maintain the requisite intake area, it was expedient to increase the intake root depth, and, in any case, this was facilitated by the greater depth of section incident upon the increased chord used, for the t/c ratio of the root at 13 per cent is the same as that of the Sea Hawk. This greater depth, in conjunction with the same fuselage, means that the contour of intersection between wing root and fuselage is considerably more curved in plan and, in fact, produces what can be likened to a "waisting."

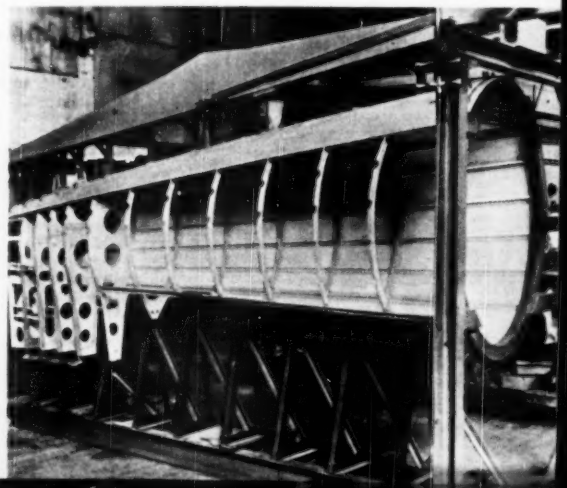
Aerodynamically, this effect is thought to offer some advantage, although quantitatively the magnitude of the effect is still largely a matter of conjecture. The reasoning is that lines of constant pressure—isobars in meteorological terms—can be plotted along the wing as a function of the flow velocities. In general, on a swept wing such as that of the 1052, these isobars run spanwise substantially parallel to the leading edge, but at the wing root tend to curve so as to meet the line of intersection with the fuselage at a right angle. The effect of fuselage waisting at the intersection is that the ends of the isobar curves are straightened somewhat: in other words, the induced velocities are lowered and, therefore, the effective drag is reduced.

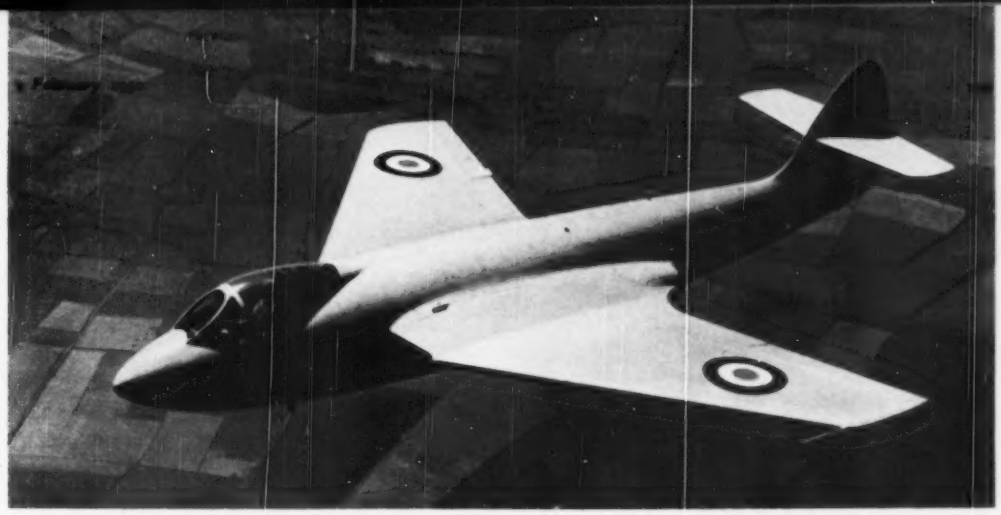
Although the thickness chord ratio of the 1052 wing is very nearly the same as that of the Sea Hawk, i.e., 10 per

Centre-section showing stub-wing spars and fuselage frames.



The rear fuselage is built upside down, the lower fin is integral.





This study of the second P.1052 admirably portrays the aircraft's beautiful lines. At the present time it is powered by a Rolls-Royce Nene 2 turbojet of 5,000 lb thrust.

cent, the aerofoil section has been changed. It is, in fact, a symmetrical section, the greatest depth of which is at 34 per cent chord. (Although, incidentally, the Germans believed that the highest critical Mach number with a swept wing was obtained from a symmetrical section and no twist, it has now been discovered that this is not wholly true, and, for the high-altitude case particularly, a certain amount of camber and twist can show beneficial results.) The section designed by Hawkers for the 1052 embodies a well-rounded leading-edge profile, whereby the stall characteristics are generally improved, whilst at the opposite end of the scale, the high-speed characteristics are enhanced by the use of a narrow trailing-edge angle. Ailerons are 7 per cent of the wing in area and are fitted with torsion-bar spring-tabs of the well-established Hawker type; both aerodynamic and mass-balancing are used.

The tailplane at present fitted to the aircraft is essentially the same as that used on the Sea Hawk except that the span has been reduced by the deletion of rounded tips and the substitution of squared-off tips. It is, undoubtedly, its thin section (9 per cent) that makes the tailplane serve well at the high end of the speed range but, even so, the stick forces are not as light as could altogether be desired, and there is every likelihood that, with the fitting of a swept-back tailplane, they will be somewhat reduced.

To cater for trim change at the upper limits of speed, the tailplane attachment has been modified so as to permit adjustment over an incidence range of 5 deg. The actual adjustment of tailplane incidence is effected with a screw-jack mounted vertically in the lower portion of the fin, appropriate movement being derived via cables from a "pump handle" on the pilot's left in the cockpit. At the base of the handle are two pawls oppositely engaging a pair of free-running cogs which commonly mesh with a bevel pinion integral with the cable sprocket. By this means, continuous rotation of the cable sprocket is obtained with pumping of the handle, and by reversing the throw of the pawls (by a small lever fitted on the handle) the direction of cable movement is reversed. This system has the merit of being simple and adequate, but substitution by an electric screw-jack system is envisaged for the future.

For the benefit of those who missed our analysis of the Sea Hawk, we feel that, before going on to deal with the 1052 structure, a brief description of the fuselage might prove valuable.

The nosecap is given over to nosewheel stowage (the strut retracts forward), and immediately aft of this is the spacious and neatly provisioned cockpit, the occupant of which is furnished with an ejector seat, and enclosed with a blown Perspex canopy of admirable form. Behind the cockpit is the front tank cell, the rear bulkhead of which forms the forward wall of the engine compartment. The latter volume is divided into three, the central portion being a plenum chamber from which the Rolls-Royce Nene is aspirated.

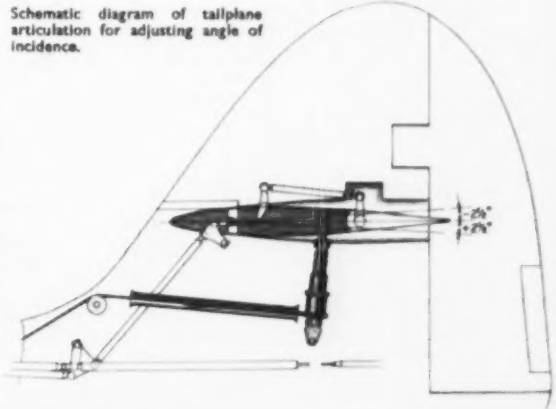
In the rearward portion of the engine compartment, space on each side of the turbine in the fuselage flanks is given over to stowage of the main wheels. Bifurcation of the jet exhaust by means of "trouser-leg" pipes, a unique feature of the Sea Hawk and 1052, permits the space between the jet pipes to be devoted to fuel stowage.

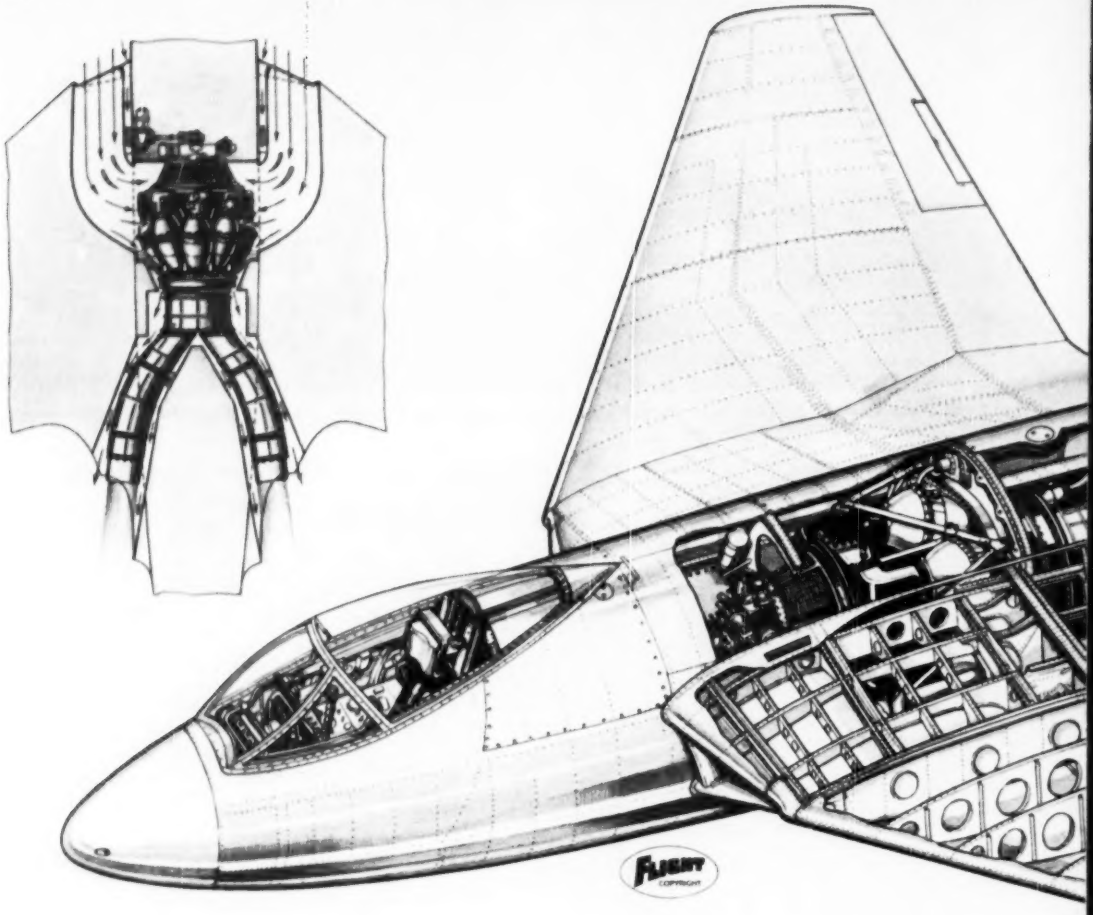
From this station rearward, the fuselage structure is an orthodox semi-monocoque, in which the bottom part of the fin is incorporated as an integral element. Apart from the change in tailplane arrangement, the rudder has also been altered somewhat from that used on the Sea Hawk, in that the lower 13in is a fixed extension of the fin. The consequent reduction in rudder area has not carried any penalty, for the original area was generous and that now used is entirely adequate; in point of fact, the modification is something of an advantage, for not only has it resulted in the elimination of a coarse trailing edge to the rudder base, but has also made the rudder lighter in weight, which in turn has allowed the use of a reduced balancing mass.

Structurally, the chief change in the centre-section stub wing arrangement is that the front attachment point has been moved forward and the end-rib moved inboard to the undercarriage anchorage station. Mention has already been made of the lower aspect ratio intakes, but in that the leading edge of the wing now meets the fuselage farther forward, the length of the intake trunking is somewhat greater. There may well be aerodynamic advantage in this, for although the skin friction in the intake ducts will inevitably have risen a small amount, the narrower divergence-angle used is likely to have more than compensated the frictional losses by reducing the diffuser losses.

Whereas the front attachment point of the wing outer

Schematic diagram of tailplane articulation for adjusting angle of incidence.





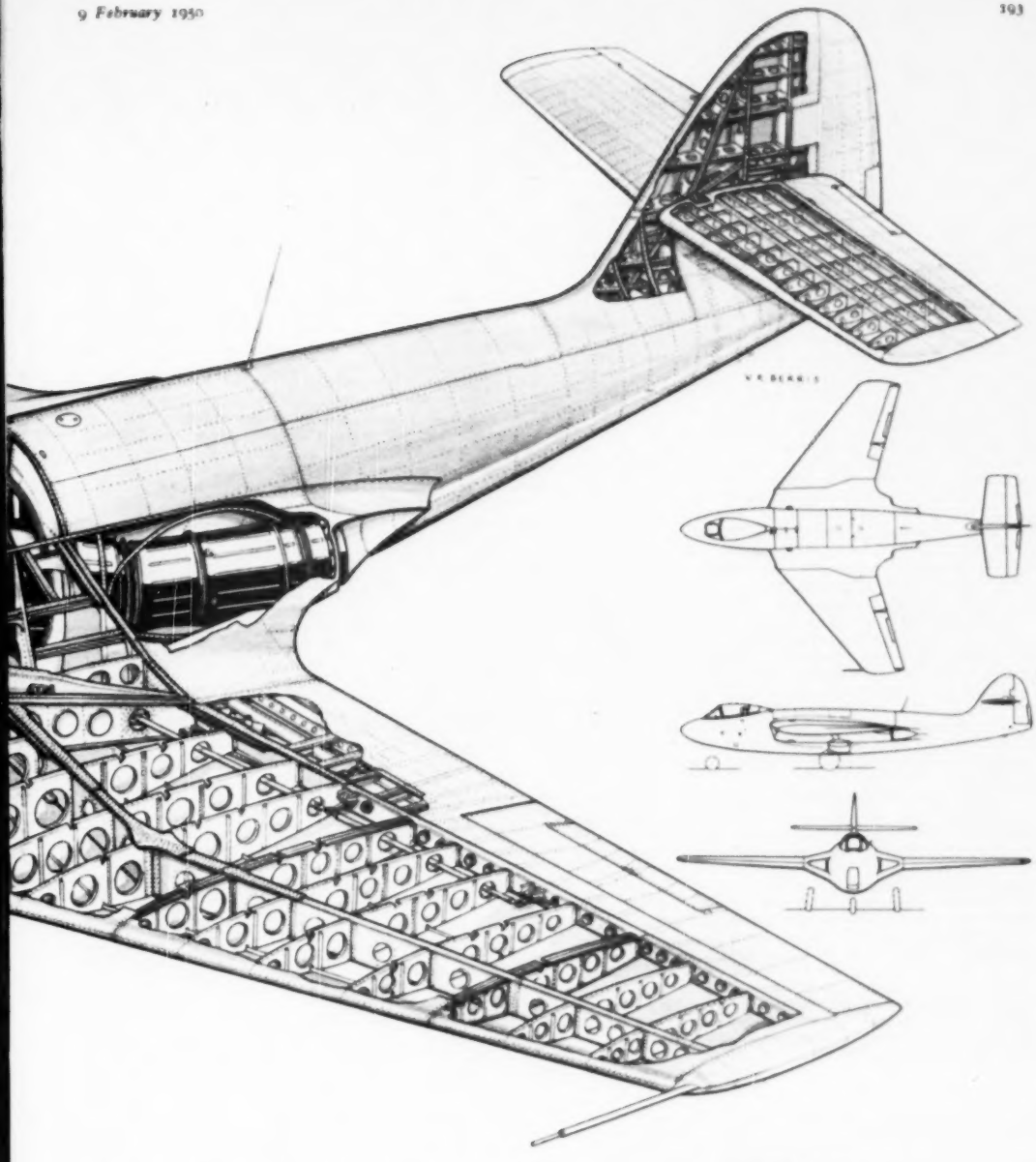
The illustrations on this page have been deliberately chosen as direct complements of those which *Flight* published for the Sea Hawk, so that a direct comparison between the two aircraft can the more easily be made. Apart from the change in wing shape, the drawing clearly shows the intrinsic form of stub-wing structure, and the narrower and longer intake trunks of the P.1052.

P.1052 . . .

panels was made on the Sea Hawk at the extremities of stub wing booms carried off the front diaphragm of the engine plenum chamber, the front attachment booms on the 1052 are anchored to the front bulkhead of the engine compartment. This has not incurred the deletion of the stub wing booms from the front plenum diaphragm, it has merely resulted in their being reduced in scantling. The front bulkhead of the engine compartment is a twin-walled diaphragm with a rolled-channel peripheral-member. Attached by side-plates to this are double-channel-section spanwise ribs over and under the intake trunks, joining outboard for mounting of the spigot which actually forms the forward attachment point of the outer wing panel. The intake trunking is supported on a gridwork of pressed channel-members, to which the external skin (i.e., of the stub wings) is also riveted. The centre-section main spar design is similar to that of the Sea Hawk in employing continuous light-alloy angle-section extrusions with plate-webs which are, in fact, integral with the rear plenum chamber diaphragm.

Abaft the main spar, the undercarriage girder slopes outboard at an angle of approximately 20 deg and is formed by two heavy-gauge pressed webs with extruded angle booms. We have already stated that, except in length of leg, the Dowty undercarriage used on the 1052 is essentially similar to that found on the Sea Hawk, but the leg anchorage arrangement has been somewhat simplified. As shown in the detail drawing, the crosshead of the leg is anchored in a pair of plummer blocks and, by unscrewing the four nuts securing one block and the three nuts securing its fellow, the leg can be unshipped. The rear spar in the stub wings is basically a lighter-scantling variant of the main spar, and the upper surface skin panelling is carried on rolled, top-hat fore/aft members in conjunction with Ω-section spanwise stringers; the lower surface is largely made up of undercarriage fairing panels and doors.

The stub wing structure abaft the rear spar is a simple skin roof to the recesses for the inboard portions of the split flaps. Although the flaps themselves have been slightly modified in shape, recourse is still made to a port/starboard interconnection system of universally jointed



torque tubes, flap actuation being derived from a pair of Dowty hydraulic jacks mounted one in each stub wing and supplied from a common source.

Attachment of the outer wing panels to the stub wings is made at the main spar with high-tensile-steel multiple bolts uniting the fork-and-lug-jointed booms. The main spar booms of the wing proper are unusual in being machined from extruded angle-section steel members. These run outboard a distance of 3ft 7in from the joint, whilst progressively tapering in sectional dimensions, and at their extremities are supplemented by fish-plates which provide doubling reinforcement for transition to the heavy-gauge pressed-channel member which forms the main spar for the remainder of the span. As may be seen from the illustrations, this transitional point in the main spar structure

HAWKER P. 1052
One Rolls-Royce Nene 2 Turbojet

Span	31ft 6in
Length	37ft 9.5in
Height	10ft 1in
Wheelbase	12ft 9in
Track	7ft 11.5in
Wing area, gross	258 sq ft
Aspect ratio	3.84
Standard mean chord	8ft 2.5in
T/c ratio	10 per cent.
Dihedral	1 deg 45 min
Incidence	0 deg 30 min
Sweep-back, leading edge	40 deg
at quarter chord	35 deg
trailing edge	15 deg 30 min
Tailplane span	11ft 3in
Tailplane and elevator area, gross	36.5 sq ft
Tailplane incidence, range	5 deg
nominal setting	+ 1 deg
Fin and rudder area, gross	21.5 sq ft

P.1052 . . .

is also the point from which the spar is swept back.

The rear spar has a plate-web furnished with extruded angle-section booms which are taper-machined to a die-away point roughly 10in inboard of the aileron. From here out to the tip, the plate-web of the spar is flanged to become a pressed channel-section member. Attachment of the rear spar to its complement in the stub wing is by means of steel bridge-straps through-bolted with the booms. These spar joint arrangements are illustrated in an accompanying detail sketch, from which can also be seen the extremely strong inboard end-rib used on the outer wings. The rib diaphragm is riveted to extruded T-booms, and between the wing skin and the boom flange is interposed a stainless steel reinforcing strip, extending approximately 12in forward and aft of the main spar station. The purpose of such reinforcement is to compensate for the break in the end-rib booms necessitated for passage of the spar joint fittings.

Wing skin-plating is reduced in thickness spanwise; that at the inboard end is 10 gauge as far as one rib bay outboard of the spar crank, thickness thence changing to 12 gauge over the next four rib bays, thereafter being 14 gauge for the remaining span out to the tip. Forward of the main spar, the skin panels are in upper and lower sections, joined along the leading edge with an internal butt-strap or doubling strip. Aft of the main spar, the skin gauges are similarly 10, 12 and 14 back to the rear spar, but inboard of the ailerons, the upper skin surface roofing the flap recess is reduced to 20 gauge.

Chordal ribs are pressed sheet diaphragms with flanged contours and the webs are liberally pierced with flanged lightening holes. At the joints in the skin plating, however, the ribs are fitted with extruded T-booms and above the boom flanges are interposed butt-straps beneath the adjacent edges of the skin panels. Two extruded angle-section stringers, running broadly parallel to the main spar, are used for additional stabilization of the upper surface of the wing, the ribs being slotted for passage of the stringers and attached to them with small angle brackets.

In way of the aileron, the rear spar web carries small vertical brackets on which the curved wall of the aileron shroud is supported. The shroud lips are formed by the trailing edges of the wing skins which are supported by miniature cantilever brackets machined from light alloy T-section extrusions.

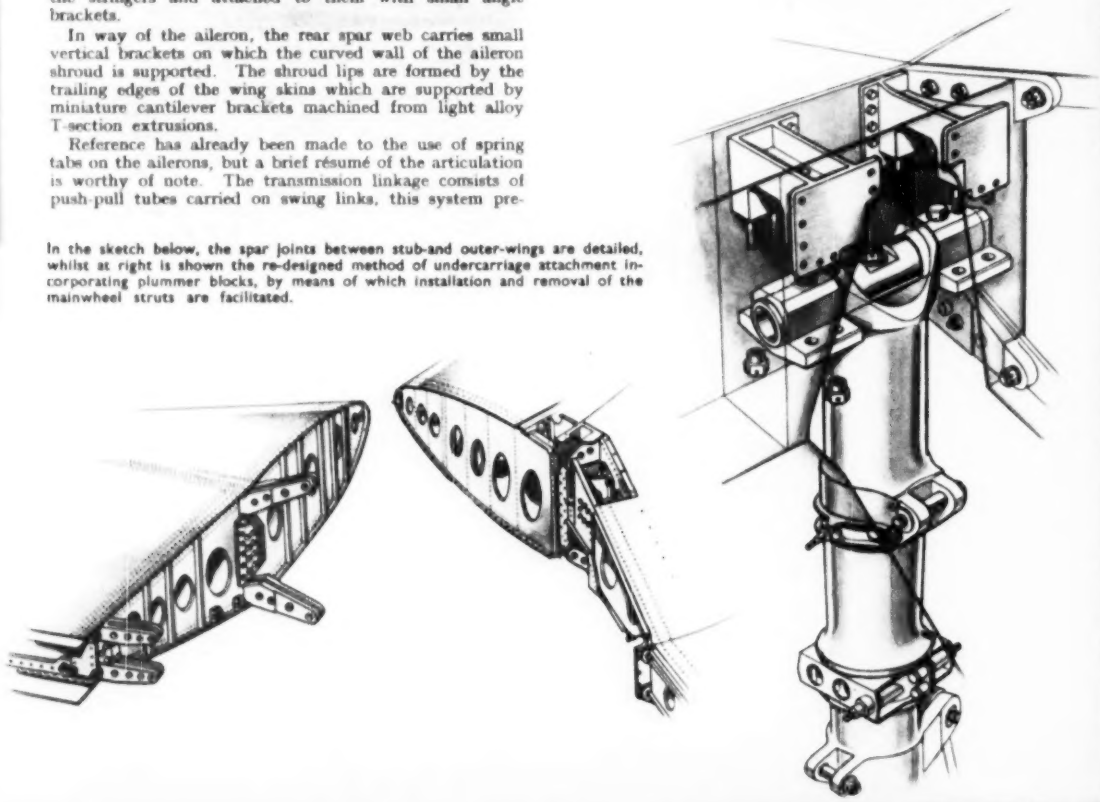
Reference has already been made to the use of spring tabs on the ailerons, but a brief résumé of the articulation is worthy of note. The transmission linkage consists of push-pull tubes carried on swing links, this system prevailing from the cockpit, down the fuselage, and out along the wing approximately to mid-aileron span.

Here, transition is made through a bell-crank carried on the front face of the rear spar and linked to the torsion bar. This is mounted spanwise close to the aileron hinge axis and is directly connected to the trailing-edge tab. The latter, incidentally, is approximately of 30in span by 5in chord and is mounted about 8in from the inboard end of the aileron.

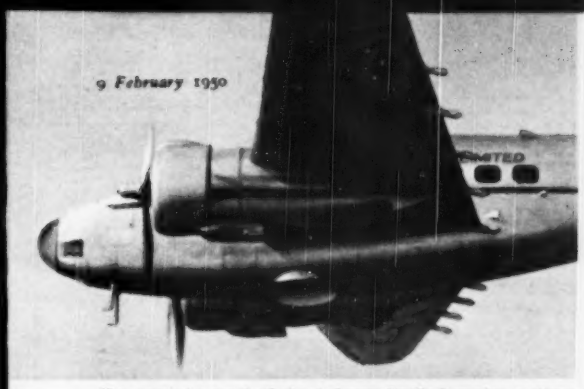
Trimming arrangements for the tail surfaces do not follow the aileron precedent and, instead, the elevators are each furnished with a conventional pilot-operated trim tab, whilst the rudder employs an electrically actuated tab. This latter is powered by a small, Rotax rotary actuator complete with integral reduction gear, which is mounted in the leading edge of the rudder with its axis substantially vertical. On the output shaft from the reduction gear is an eccentric-cam assembly, the purpose of which is to increase irreversibility, whilst at the same time providing a greater effective reduction ratio. From the eccentric, a push-pull shaft runs back through the rudder to the port side of the tab. This has a range of 5 deg and, in that the angular rate of the actuator output is 5 deg/sec, the tab rate is consonantly 1 deg/sec. Position indication is given by a Desynn system.

The two 1052s which have been completed have well over 100 hours' handling and research flying to their credit, and both Boscombe and Farnborough pilots have had an opportunity to report on their flying characteristics. They have reported that the 1052 is a pleasant aircraft to fly, being free from any vices likely to endanger the safety of the aircraft, and having no important features likely to affect its operational capabilities adversely. By comparison with the 1040, the swept-back wings produce the desired effect of a high usable Mach number. The aircraft does, in fact, maintain a reasonably high c/l maximum up to high Mach numbers and the high-altitude manœuvrability is reported to be good and to represent a useful improvement by comparison with current straight-wing turbojet fighters.

C. B. B-W.



In the sketch below, the spar joints between stub-and outer-wings are detailed, whilst at right is shown the re-designed method of undercarriage attachment incorporating plummer blocks, by means of which installation and removal of the mainwheel struts are facilitated.



The parabolic aerial of the Airborne Profile-Recorder is shown mounted in the fuselage of a Lockheed Hudson.

Component units of the equipment: (top) the Esterline-Angus tape recorder, the receiver and indicator, and the datum stabilizer; (below) the inverter and transmitter.

GROUND PROFILES

—Recorded by Radar Altimeter: Successful New Survey Technique

FOUR years ago, the Canadian Department of Mines and Resources initiated a programme of research into the practicability of using an airborne instrumentation to assist in obtaining ground elevation information for use in topographical mapping.

Early experiments with the existing APN-1 radio altimeter proved that special instruments were required if reasonable accuracy was to be achieved. The National Research Council of Canada solved the problem by designing a precision radar altimeter for measuring terrain-clearance beneath an aircraft—an instrument capable of recording ground profiles to limits of plus or minus 10ft when flying at a speed of 200 m.p.h. Development of a similar instrument for commercial use was undertaken by the Photographic Survey Corporation, Ltd., of Toronto, and the present P.S.C. Airborne Profile-recorder is the product of lengthy research and operational experience.

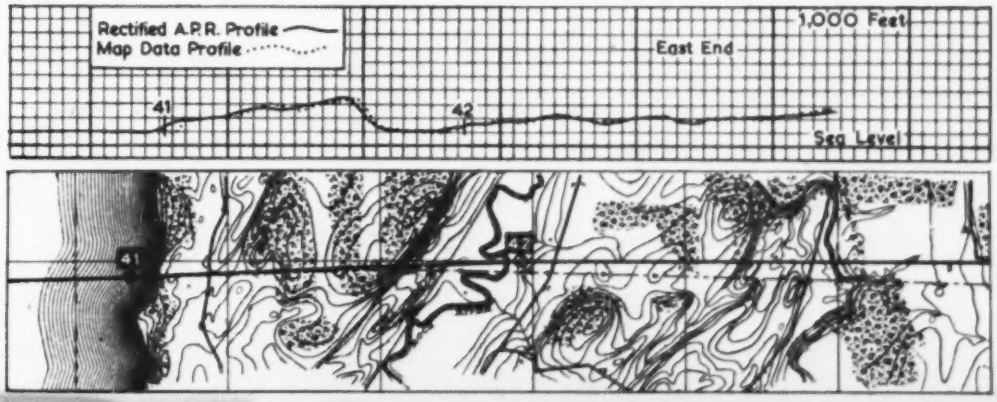
The equipment is basically an electronic altimeter utilizing a radar beam projected downwards from the airborne installation to measure the actual clearance between the aircraft and the ground. It produces an elevation profile of the ground in the form of a continuous record of such measurements taken in continuous sequence as the aircraft flies along the line to be surveyed. The operating principle, briefly, is that a radar aerial mounted beneath the aircraft directs micro-wave radiations vertically downward to the ground, while a graphic recorder on the receiving side of the radar set makes a continuous record of the terrain-clearance on a moving tape. Correlation of the record with the ground track is accomplished by synchronized vertical photography. The instant of taking a photograph is recorded by an auxiliary pen in the margin of the radar record, thereby identifying that point on the record with the ground position indicated by the centre point on the photograph. A continuous record of radar readings gives an inverted picture of the ground profile when the altitude of the aircraft is used for reference, but when the record is related to sea level it becomes a scale drawing of the ground profile.

Since the height of the aircraft above sea level (measured by a normal sensitive altimeter) is taken as the reference datum for the ground clearance readings and as, by the use of this altimeter alone it is impossible to maintain an exact constant height, a method of stabilizing the reference datum is necessary. For this purpose an electronic datum stabilizer has been developed, incorporating a small, sensitive aneroid which produces an electric current proportional to height changes without mechanically loading the aneroid. This current is fed simultaneously with the radar signal to the same recording meter in such a manner that it compensates for deviations from level flight.

This type of equipment should be particularly useful in reconnaissance work during the selection of routes for power, oil or railway lines, and particularly for providing accurate ground-elevation information to be used in conjunction with existing methods of map construction.

The P.S.C. Airborne Profile-recorder is available for commercial distribution or for hire; and it may be built to the customer's specifications of size and accuracy. Where the volume of work is not great enough to warrant the purchase of an instrument the Photographic Survey Corporation offers a complete service which includes flying, reduction and interpretation of the radar record and topographical mapping on a contract basis.

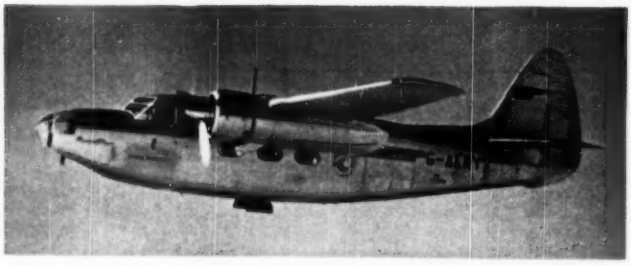
To test the accuracy of the equipment a strip of ground was chosen (shown below) which had previously been well surveyed by existing methods. The radar record is seen superimposed on the previously surveyed points; accuracy along the actual flight-line was within the specified tolerance of the instrument. The numbers refer to photographs for correlation of the radar record and the ground track.



"*Flight*" photographs

Flush-fitting camera-hatch doors allow a clean underside to the fuselage of the P.54.

THE SURVEY PRINCE



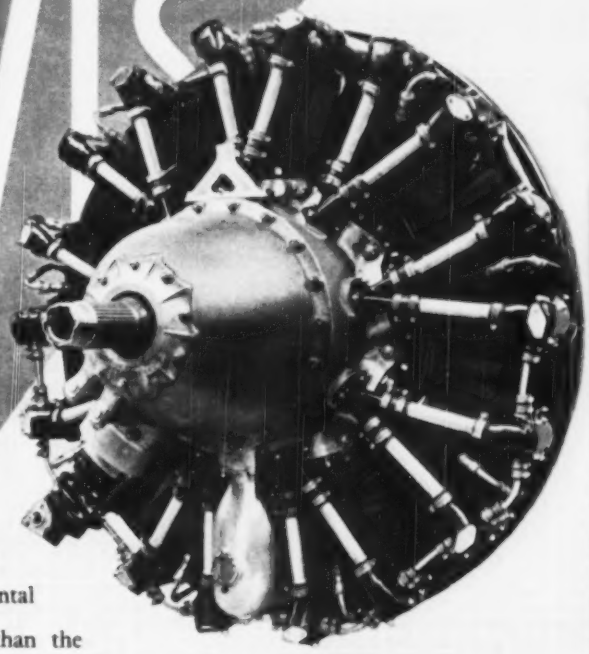
Practical Features of a Specialist Aircraft : Unobstructed Camera Fields

FOLLOWING careful study of all the requirements in an economical aircraft of suitable performance for aerial survey work, Percival Aircraft Ltd., has produced a special version—further details of which are now available—of the well-known Leonides-powered Prince. It will be recalled that the Prince was recently granted the first "normal category" C. of A. in compliance with the I.C.A.O. transport category "A" airworthiness standards. Although basically a standard Prince, the P.54 survey version has been designed to provide for the widest possible variety of camera combinations, both vertical and oblique. Two rectangular camera-hatches are situated in the floor of the fuselage, one on the c.g. and the other approximately 4ft aft. Manually operated doors, closing flush with the outer skin, protect the vertical cameras when they are not in use. For oblique photography there are two circular ports, one on each side of the fuselage aft of the high wing to permit an unobstructed view of the ground from almost directly below the aircraft to a level above the horizon. These ports are covered by transparent panels removable in flight. Used in conjunction with one of the vertical hatches, they permit photography of the trimetrogon type.

The aircraft is intended for operation by a crew of three: pilot-navigator, observer and camera/radio operator.

The world's most modern air cooled radial engine in the medium power class

ALVIS



It has nine cylinders for smooth running, with 24 per cent. less frontal area and lower weight per B.H.P. than the nearest comparable type. It develops 550 B.H.P., has an anti-icing fuel-injection system and automatic mixture and boost controls. The fuel and oil systems are unaffected by negative G. These are a few of the unique features of the

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All Dagenite batteries designed for use in the air are fitted with 'Porvic' micro-porous separators and protected intercell connectors. That is one reason why Dagenite aircraft batteries are so dependable. They are specified as standard equipment on many British aircraft.

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P.R10/49

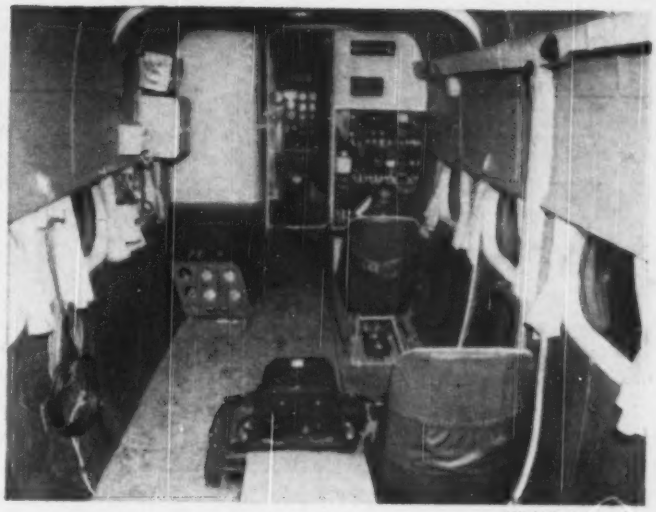
THE SURVEY PRINCE . . .

An extra seat is provided for another passenger such as a geologist or a crew member under training; all four positions are fitted with oxygen and intercommunication points.

To reduce fatigue due to sustained precision-flying the Prince is equipped with the Smith's S.E.P.1 electric autopilot and the Hughes' G.3 gyro-magnetic compass. The observer's position is in the clear-vision nose, which affords a wide, unobstructed view ahead and to a point below which is approximately 10 degrees aft of the vertical. Side panels also give an extended view so that a complete panorama towards which the aircraft is heading can be obtained.

The navigator's position is equipped with a periscopic aiming-sight, the master unit for the G.3 compass, and an inching unit which permits alterations of course in azimuth while the autopilot is in control. Also within easy reach are the intervalometer and camera controls, together with the normal instruments for speed, altitude and temperature indication. The operator's seat is adjustable to provide a maximum of comfort in whichever sighting position he may adopt.

The camera/radio-operator's position is in the main cabin on the starboard side just aft of the entrance to the pilot's compartment. Radio (which may be installed to the customer's requirements) is housed in universal racking. This compartment is also fitted with controls for regulating the flow of hot air to the camera positions and for operating the camera doors. The 24-volt power supply for the cameras and other electrical services throughout the aircraft is maintained by two 1,500-watt engine-driven generators in conjunction with 40 amp/hr storage batteries situated at the rear of the camera compartment.



"*Flight*" photograph.

This interior view of the Survey Prince shows the vertical-photography hatches, with a Williamson Eagle IX camera in one of them. The crew-stations seen are those for the radio operator (forward) and the extra member.

"*Flight*" photograph.

The crew of the Survey Prince at Luton airport before departure for Sharjah, Persia. Left to right: J. Saffery (chief pilot and expedition manager), J. D. L. Symmington (navigator-photographer), J. W. F. D. Angers (radio operator) and E. C. Goodson (engineer).

In external appearance the Survey version differs from the first Princes mainly in the considerably lengthened transparent nose; it also incorporates the new windscreen which, designed to provide better visibility in rain, is to be fitted to all future Princes. Indeed, the forward fuselage of the production versions has a much more pleasing appearance than the somewhat stubby frontal aspect of the original model.

Range and duration are, of course, of paramount importance in a survey aircraft, and the tankage of the Survey version has accordingly been increased to 226 gallons, giving a range of approximately 1,300 miles in still air at 155 m.p.h. The aircraft will climb to over 23,000 ft with full load and can maintain height on either engine at 12,000 ft.

At a ceremony at Luton Airport on January 31, the first Survey Prince was officially handed over to Hunting Aero-Surveys, Ltd. It was due to embark the same day, after customs clearance at Bovingdon, on an expedition to photograph some thousands of square miles of southern Persia for the Anglo-Iranian Oil Co. Very poor weather, however, prevented its departure and under greying skies and in murky visibility the best that could be achieved was a short tractor-powered journey to the apron, where the aircraft was photographed with Capt. J. Saffery (Hunting's chief survey pilot and expedition manager) and the crew.

The following figures for typical survey sorties in relation to the performance of the Prince give an indication of the suitability of the aircraft for the purpose. The fourth column assumes a payload increase equivalent to one extra crew-member.

Base-to-area mileage Fuel load (gall.)	300 226		200 226		100 226		100 200	
	hr	miles	hr	miles	hr	miles	hr	miles
Transit	3.50	600	2.40	400	1.30	200	1.30	200
Time over area ...	2.10	350	3.30	560	5.00	800	4.00	640
Reserve	1.00	150	.50	130	.30	80	.30	80
Totals	7.00	1,100	7.00	1,090	7.00	1,080	6.00	920

WET AND WINDY: According to the picture-agency caption accompanying this striking night scene from Prestwick, "the wind sock (centre background) is blowing out straight, but a giant Stratocruiser has been brought in safely."

CIVIL AVIATION NEWS

THE ECONOMY CUTS

THE Government decision to make substantial reductions in expenditure on defence has already had repercussions on the aircraft industry. Last week the Bristol Aeroplane Company announced that it had been notified by the Ministry of Supply of extensive cuts in orders, mainly for engines, while Handley Page, Ltd., also announced receipt of similar news, in this case relating to military transport aircraft.

Although the greater part of the Bristol Company's contracts, including that for the two Brabazons, are not affected, the cuts will entail an immediate reduction in manning. In a statement, the Bristol Company said: "As a result of Government instructions to economize in expenditure on new civil aircraft, B.O.A.C. is, with the Ministry of Supply, reviewing the possibility of proceeding at once with the final version of the Bristol Type 175 powered by Proteus propeller turbines, omitting the intermediate version with Centaurus engines. It is B.O.A.C.'s hope by such action both to secure the economies called for and to accelerate the introduction of the latest version of the aircraft.

Earlier introduction of the 70-seat Bristol 175, which is expected to be 75 miles an hour faster than the Constellation, would be welcomed by B.O.A.C. as a very effective means of improving operating economy; the Corporation has ordered 25 aircraft and had expected delivery in 1953 or 1954.

In *Flight*'s view, the drastic cuts which the economy measures impose on equipment for Transport Command—at present being supplied with Hercules-powered Handley Page Hastings and Vickers-Armstrongs Valettas—emphasizes even more strongly the need for a powerful civil air fleet which will act as a potential reserve for the military transport forces, not only to provide aircraft and crews, but to keep in being a well-trained force of maintenance personnel.

MAP INACCURACY

IN *Information Circular No.* 12/50 the M.C.A. draws attention to the unreliability of spot heights indicated on air charts for many of the areas outside Central and Western Europe. "There are few thoroughly well-mapped countries," says the circular, "and over large areas of the world information is scanty or inaccurate. G.S.G.S. maps of these areas are compiled from best available data, and where information is conflicting, with no indication of relative reliability, the guiding principle has always been to select the highest value. Unless the area concerned is known to have been reliably surveyed, spot heights and layer-tinting should be regarded as an indication of topography rather than as accurate statistics. Pilots and navigators are requested to notify any gross errors which they are able to establish with reasonably certainty."

One of the typical corrections detailed in the circular involves the addition of over 300 metres to one spot height.

HERMES IV TROPICAL TESTS

TO-DAY, February 9th, the Hermes IV, captained by H. G. Hazelden, Handley Page chief test pilot, was due to leave Radlett for Hurn, whence it will proceed to Castel Benito on Friday and Khartoum on Saturday. It is expected to be away for about two weeks, and the purpose of the visit is to complete the final tests for tropical endorsement to the C. of A. All performance tests for a normal C. of A. have now been carried out, and B.O.A.C. has commenced crew training on the machines. The crew of 17 will include navigation officer McKinley, B.O.A.C.; radio officer A. E. Potter; flight engineer F. S. Green; chief observer I. K. Bennett; assistant observer J. H. Pitt; camera operator Sexton; B.O.A.C. observers Redgate and Collinge; Bristol engine-observer Botting; A.R.B. observer H. G. Radlett; and P. A. Talbot, observer for Smiths Instruments. In addition there will be a ground crew of five.

Twenty-three Hermes IVs of the order for twenty-five have now been delivered to Radlett and assembly of the majority has been completed.

YUGOSLAV REORIENTATION

IT is reported from Belgrade that air services between Yugoslavia and the Cominform countries have been drastically reduced. Russian aircraft must now obtain permission for every flight over Yugoslav territory. All flights by Yugoslav aircraft to Prague and other Communist capitals have been stopped and complete severance of all air links between Yugoslavia and eastern Europe is expected by the middle of March.

Until recently a regular Soviet service was operated from Moscow to Tirana, via Belgrade, but now the Yugoslav Government has decreed that each individual flight must receive prior approval; very few Russian aircraft other than those carrying Soviet diplomats fly to Belgrade.

Czechoslovakian aircraft still operate a twice-weekly service on the Prague-Belgrade-Sofia route, but it is said that Yugoslavia has no intention of renewing the bilateral air agreement with Czechoslovakia, which is due to expire on March 14th. Hungarian and Bulgarian air services to Yugoslavia have already been discontinued and further bilateral agreements with Roumania and Poland have never been implemented by either country.

Meanwhile, the first Pan American test flight to the Yugoslav capital was made recently, but was reported to have been unsuccessful owing to the weakness of radio signals and failure to synchronize transmitting and receiving frequencies. A further test flight from London to Belgrade was scheduled for February 5th. As soon as C.A.A. approval has been given for the radio facilities, P.A.A. will commence regular flights to Yugoslavia. Additionally, the company will save some 700 miles on its Vienna-Istanbul run by flying a direct route instead of the previous detour over the Adriatic and Italy.

THE CHARTER MARKET

CURRENT business on the air-freight market is showing a tendency to be considerably more active than in the past few weeks. Rates offered by shippers are quite low, but there are signs that the market generally is reviving, and most brokers take the view that exporting aircraft will not have difficulty in finding loads in the immediate future. The carriage of passengers is still more intense than freight, and a large proportion of present fixtures is for the transport of ships' crews. There is, additionally, a steady flow of enquiries from tourists

requiring transport to Rome for the Holy Year celebrations, and a number of fixtures have already been effected.

It is encouraging to note that this summer there will be a larger proportion of scheduled air services operated by charter companies under associate agreements with B.E.A. than was the case last year. In 1949, 37 charter companies were granted contracts, 17 of which are still valid. Contracts have already been given to 40 companies for routes which are not encompassed by the B.E.A. network, 25 of this number representing entirely new services. Meanwhile, applications (of which there are 140) are still under consideration for a further 40 contracts.

Certain routes, however, particularly those from London to the Channel Islands, are to revert to exclusive operation by B.E.A. Under the terms of the Civil Aviation Act, scheduled services are reserved for the State Corporations; their operation by charter companies is in accordance with last year's decision by the Minister of Civil Aviation to permit charter firms to operate them under associate agreements with B.E.A. until the Corporation itself is in a position to provide all the scheduled services in this country. B.E.A. states that all the traffic from London to the Channel Islands can now be handled by its normal flights, and the contract for extra services by a charter company has therefore been withdrawn.

B.O.A.C. REDUNDANCY

In view of the increased capacity of its present and future replacement aircraft, and its consequent ability to carry considerable loads of freight in addition to passengers, B.O.A.C. is considering closing its No. 5 (all freight) Line and incorporating the freight services within its general Line structure. While such a move may have a beneficial effect on the Corporation's operating economy, it must also inevitably involve reduction in personnel-strength.

The Aeronautical Engineers' Association has stated that, in view of previous assurances that redundancies would be spread in equal proportions between the two Corporations, it has decided to ask the Minister of Civil Aviation to receive a deputation; meanwhile it has requested cancellation, or at least postponement, of B.O.A.C.'s proposed action until after the General Election.

The Corporation states that the whole matter is at the moment the subject of discussion with the National Joint Council of Civil Air Transport, and at a meeting last Friday it was made clear that the Corporation did not intend that the impact of the reductions should be borne only by No. 5 Line.

It is obviously essential to effect every possible economy in an effort to reduce the operating deficit; at the same time, the potential value of civil air transport as a reserve in time of emergency makes it important that the services of trained engineers should not be irretrievably lost to aviation. From this point of view it is to be hoped that the Corporation will find some way of reducing its cuts to the minimum.

B.E.A. SUMMER PROGRAMME

THE inauguration of several new routes as well as increased frequencies on existing services and faster schedules to the Mediterranean are features of B.E.A.'s programme for this summer. The majority of the new schedules will be put into operation on April 16th, but certain purely seasonal routes will be introduced at a later date. Among the new services will be a thrice-weekly return flight from Glasgow to Paris, via Manchester, one from Manchester and Birmingham to Jersey with connections to Dinard and a Birmingham-Belfast service.

Among measures to speed-up existing services will be non-stop London-Rome flights, and these will provide faster schedules between Rome and Athens; additional London-

(Continued on page 200)

British Airways' Operation Statistics for October, 1949

(Figures for the corresponding period in 1948 are given in parentheses)

	B.O.A.C. All Divisions	B.O.A.C. Western Division	B.O.A.C. Eastern Division	B.O.A.C. South American Division	B.E.A. All Divisions	B.E.A. Continental Division	B.E.A. British Division
Total revenue aircraft-miles	2,333,161 (2,940,410)	279,983 (355,785)	1,654,278 (2,081,026)	398,900 (503,599)	1,364,307 (1,082,840)	982,332 (669,033)	381,975 (413,807)
Total aircraft miles	2,677,386 (3,235,875)	330,439 (420,355)	1,895,805 (2,256,707)	451,142 (558,723)	1,296,316 (1,104,516)	925,879 (681,751)	370,437 (422,765)
Revenue passengers carried	12,854 (12,453)	3,188 (3,043)	8,207 (7,713)	1,459 (1,697)	60,537 (49,738)	30,744 (20,135)	29,793 (29,603)
Revenue passenger miles	37,525,610 (37,210,749)	7,930,081 (6,757,589)	27,185,482 (25,432,528)	2,410,047 (5,020,632)	17,628,933 (14,072,136)	12,327,614 (9,119,560)	5,301,319 (4,952,576)
Available seat-miles	60,778,749 (58,392,539)	11,164,080 (11,259,641)	42,734,220 (38,325,846)	6,880,449 (8,807,072)	26,674,097 (19,628,435)	18,721,436 (12,858,589)	7,952,661 (6,759,846)
Revenue passenger load factor (per cent)	61.7 (63.7)	71.0 (60.0)	63.6 (66.4)	35.0 (57.0)	66.1 (71.7)	65.8 (70.9)	66.7 (73.3)
Cargo carried (tons): Mail	142.8 (159.1)	34.4 (26.7)	97.0 (113.1)	11.4 (19.3)	282.9 (230.3)	186.3 (136.8)	96.6 (93.5)
Freight	294.3 (317.8)	41.8 (51.4)	216.9 (220.2)	34.6 (46.2)	537.6 (492.1)	393.6 (385.8)	144.0 (106.3)
Total revenue load ton-miles	5,514,166 (5,481,930)	992,464 (867,575)	4,064,495 (3,778,794)	457,210 (835,571)	1,962,362 (1,516,171)	1,396,650 (1,089,117)	465,712 (427,054)
Total usable capacity ton-miles	10,112,728 (9,386,074)	1,516,512 (1,578,119)	7,011,277 (6,097,016)	1,584,939 (1,710,939)	3,025,561 (2,171,041)	2,291,735 (1,522,884)	734,226 (648,157)
Overall revenue load-factor (per cent)	54.7 (60.3)	65.4 (55.0)	58.2 (62.1)	28.8 (58.8)	63.8 (70.2)	63.6 (71.6)	64.2 (66.7)
Total revenue hours	11,570 (15,804)	1,186 (1,585)	8,325 (11,711)	2,059 (2,508)	8,594 (7,623)	5,457 (4,093)	3,137 (3,540)
Total non-revenue hours	1,982 (1,646)	266 (238)	1,345 (1,010)	371 (298)	590 (355)	185 (94)	85 (79)
Equivalent annual utilization (revenue hours) per aircraft	1,568 — —	— — —	— — —	1,345 (1,336)	1,176 (1,222)	1,441 (1,474)	886 (1,024)
Unduplicated route miles in operation at end of period	67,511 (91,274)	7,725 (8,523)	43,701 (57,872)	16,085 (24,879)	12,569 (12,360)	9,994 (9,702)	2,575 (2,666)
Percentage regularity	99.0 (99.4)	97.0 (100.0)	99.3 (99.9)	99.5 (96.8)	97.2 (97.2)	97.7 (97.6)	96.9 (97.0)
Average length of stage flight (miles)	1,060 (975)	1,089 (1,095)	1,079 (952)	973 (998)	283 (193)	340 (303)	103 (113)

IN October, 1949, the British Airways Corporations and B.E.A.'s associated operators carried 75,500 passengers, a 19 per cent increase over the figure for the corresponding month of the previous year. Passenger-mileage increased by 8 per cent to 55 million, and further increases of 9 and 28 per cent were seen in the carriage of mail and freight respectively. The total of aircraft-miles flown by all the Corporations revealed a decrease of nearly 10 per cent from last year's figure; the capacity ton-mileage, however, increased by 15.6 per cent.

B.O.A.C. carried nearly 13,000 passengers over 37½ million passenger-miles, 2½ million of this total being accounted for by the South American division. B.E.A. flew 17½ million passenger-miles—an increase of 25 per cent over last year's figure. The Continental division, in particular, showed a big increase—35 per cent—and flew some 12 million passenger-miles. Charter companies operating scheduled services under associate agreements with B.E.A. flew nearly 200,000 passenger-miles.

In consequence of the merger of B.S.A.A. with B.O.A.C. on August 1st, 1949, current statistics for the routes formerly operated by B.S.A.A. are shown in the South American division of B.O.A.C. and are included in the figures for all divisions of that corporation.

CIVIL AVIATION NEWS . . .

Nice, and London-Bordeaux services are also scheduled. Frequency increases on the London-Paris route will give a total of 12 return flights daily, five of which will be at the £10 excursion rate. Five services a day will be flown between London and Dinard. Additional flights will be scheduled at week-ends and holiday periods according to the traffic demand.

B.E.A.'s traffic statistics for 1949 show that 143,736 more passengers were carried than in the previous year. Freight and mail also increased by 1,245 and 1,199 tons respectively. Revenue passenger-mileage increased by some 30 million, 80 per cent of which was achieved on Continental services.

HONG KONG ACTIVITY

ALTHOUGH no official announcement has yet been made, the annual report of the Hong Kong Civil Aviation Department reveals that a site on the shore of Deep Bay has been chosen for the new airport to replace Kai Tak. The British Government has agreed to lend £3,000,000 towards the cost of construction. The air approaches to the existing airport are difficult, and delays and diversions are inevitable in bad weather. The report expresses satisfaction, however, at the way in which the large number of aircraft and passengers have been handled during the past year.

In 1949 a total of 318,525 passengers flew into and out of the airfield, and 6,129,823 kg of freight were handled. A considerable fall in traffic was seen after October, as a result of the political troubles, which led to the cessation of flying by the China National Aviation and the Central Air Transport Corporations.

SOUTH AFRICAN AIRPORTS

THE view has been expressed in South Africa that the Government must take far-reaching decisions to provide for handling the air traffic of the future. The largest airport planned to date—the Jan Smuts airport on the Rand—will be too small for the largest aircraft now being built. "On this international airport and the two airports for internal services at Cape Town and Durban, on which construction has now been virtually suspended," says an article in the *Cape Argus*, "the South African Government has already spent £5 million and total expenditure is expected to amount to £12 million. The problem is to forecast what kind of facilities future aircraft will require and how these may be profitably provided by the State.

"An increasing number of aeronautical experts," says the correspondent, "now forecast a swing-over to flying boats because of the high cost and limitations of airports designed for handling aircraft which may be many times bigger than the largest yet flown."

U.K. AIRPORTS IN SEPTEMBER

ACTIVITIES at United Kingdom airfields during September, 1949, included the handling of more than 250,000 passengers, of which only 16,000 were in transit. Northolt accounted for 78,000 and London Airport 45,000, with Glasgow the third busiest (16,700). Normal freight was heaviest at London (700 tons), Northolt (480 tons) and Blackbushe (110 tons), but the Le Touquet car ferry again resulted in a high freight figure for Lympne (570 tons). The total of freight handled at all airports was 2,350 tons. Detailed figures for the larger airfields are given below.

Airfield	Aircraft Movements			Passengers (terminal and transit)	Freight (lb)
	Air Transport	Other Flights	Total		
Aberdeen (Dyce)	255	815	1,070	1,559	19,550
Belfast (Nutts Corner)	798	92	890	14,356	82,897
Birmingham (Elmdon)	405	1,666	2,071	3,014	16,683
Blackbushe	180	976	1,156	2,442	243,681
Blackpool (Squires Gate)	688	8,253	8,941	2,749	26
Bovingdon	184	1,496	1,680	2,944	187,218
Bristol (Whitchurch)	106	1,049	1,155	166	—
Cardiff (Pengam Moors)	533	2,251	2,784	2,181	220
Croydon	838	1,096	1,924	3,145	141,881
Edinburgh (Turnhouse)	220	910	1,130	3,027	2,710
Gatwick	135	715	850	1,117	112
Glasgow (Renfrew)	1,302	500	1,802	16,718	61,314
Hurn	20	2,479	2,499	53	—
Isle of Man (Ronaldsway)	1,905	191	2,096	16,603	31,856
Inverness (Dalcross)	314	53	367	2,849	7,263
Kirkwall	404	37	441	2,286	36,211
Leeds (Yeadon)	270	811	1,081	894	—
Liverpool (Speke)	791	724	1,515	10,475	73,859
London	2,315	1,462	3,777	45,436	1,552,216
Lympne	432	1,064	1,496	1,570	1,279,890
Manchester (Ringway)	1,115	1,285	2,400	12,494	216,723
Northolt	4,265	1,200	5,465	78,383	1,080,183
Nottingham (Tollerton)	12	873	885	89	—
Prestwick	853	613	1,466	11,825	61,899
Shoreham	22	1,450	1,472	95	—
Southampton (Eastleigh)	745	935	1,680	6,689	47,701
SouthamptonWater	88	208	296	2,180	58,739
Weston-Super-Mare	264	1,103	1,367	1,213	—
Wick	315	25	340	655	818
Other Airfields	1,336	486	1,722	6,453	60,100
All Reporting Airfields	21,010	34,803	55,818	253,660	5,263,750

BREVITIES

THE Ministry of Civil Aviation announces that the Parliamentary Secretary, Mr. G. S. Lindgren, has appointed Mr. R. F. Prosser, M.C., to be his private secretary.

* * *

Members of the United Nations Commission on Eritrea will use a chartered Viking of Hunting Air Travel, Ltd., for their journeys on this side of the Atlantic. The party left Hurn last Saturday for Asmara.

* * *

All states in Australia have decided to approve the increase of 4d per gallon in the cost of aviation spirit; airline companies have announced that this will inevitably mean an increase in fares on all routes.

* * *

Sabena is offering for sale its fleet of D.H. Doves which were used on feeder services in the Belgian Congo. They will be replaced by DC-3s, which have now become redundant on European routes.

* * *

A meeting of the West African Air Transport Authority, which comprises the Governors of Gambia, Sierra Leone, the Gold Coast and Nigeria, recently discussed possibilities of a new route to link West Africa with Khartoum.

* * *

A. Cdre. A. V. Harvey is to join the board of Silver City Airways. His appointment is associated, no doubt, with the expansion which is planned for the Lympne-Le Touquet car ferry service.

According to Sir Patrick Dollan, chairman of the Scottish Advisory Council on Civil Aviation, Scotland has, proportionately, the most airminded population in Europe. In 1949 the total number of passengers carried on B.E.A. routes (exclusive of associated companies) was 141,800, an increase of 20,000 over the previous year. In addition, Aer Lingus carried 23,200 passengers on the Glasgow-Dublin route as compared with 18,817 in 1948.

* * *

Airwork, Ltd., has again been successful in securing renewal of its contract with the Sudan Government to operate the leave service between London and the Sudan, for which the company has been responsible since the service was inaugurated in August, 1946.

* * *

The Belgian company Cobeta announces the suspension, until further notice, of its scheduled services between Manchester and Brussels and between Lydda and Haifa. The services between Brussels and Lourdes and between Manchester (or Gatwick) and Zoute, on the Belgian coast, which last year were flown in association with John Mahieu Aviation, will not be operated this summer.

* * *

Subject to confirmation by I.A.T.A., Air France announces the preliminary outline of its summer schedules. Nine services daily will be flown between London and Paris, all by four-engined aircraft, and the French Riviera will be served by ten direct return flights from London weekly. The Paris and Riviera services from Birmingham and Manchester will con-

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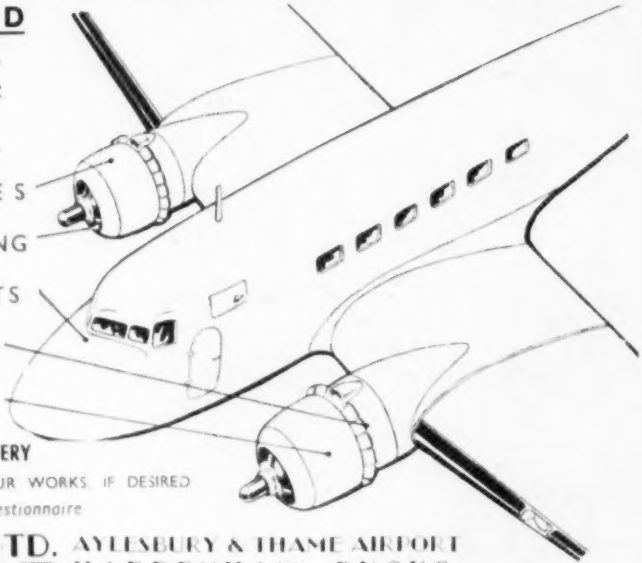

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CIVIL AVIATION NEWS

tinue on an augmented scale and the Glasgow and Belfast routes, suspended for the winter months, will re-open on April 16th and May 26th respectively. The London to Dinard service will be flown 16 times weekly and new routes will be inaugurated from Manchester, Glasgow and Belfast to the popular Brittany resort.

* * *

The appointment of Mr. Max Stuart-Shaw to be commercial manager to Aer Lingus is announced. He was previously traffic manager of the company and now assumes overall control of all its commercial affairs whilst still retaining direct responsibility for the traffic department.

* * *

Pan American World Airways announces conclusion of an air cargo agreement with the Flying Tiger Line. The agreement provides for shipments on one way-bill from any of the 43 cities which are served by the Flying Tiger company to any point on the six continents served by P.A.W.A. The joint announcement states that the new arrangements will permit publication by both companies of through cargo rates.

* * *

Mr. J. H. Robson, O.B.E., has been appointed B.O.A.C.'s general manager at London Airport as from February 1st. Since 1946 he has been manager of the Corporation's Repair Division. Mr. G. R. Hawtin, M.B.E., formerly station manager at London Airport since the Corporation's move from Hurn in 1946, now becomes traffic manager.

* * *

United Airlines completed a record 98 per cent of its scheduled mileage during 1949; approximately 260,000 flights were made. This creditable figure of schedule reliability for such large-scale operations was attributed to the employment of the multiple "best-weather route" system and greater use of electronic landing and navigation aids throughout the U.S. Douglas DC-6s are now used on 70 per cent of the company's services.

* * *

Three United Airlines operations officials are this month making a personal tour to study aircraft manufacture and development in Canada, the United Kingdom, Scandinavia and Western Europe. Mr. J. A. Herlihy, United's vice-president (operations) says that although jet and turboprop power units will be studied, the main purpose of the trip will be to observe all current aspects of foreign commercial-aircraft operation.

* * *

Expecting heavy traffic as a result of the abolition of currency restrictions for tourists to Norway, Sweden and Denmark, the Scandinavian Airlines System announces that daily services will be operated between London and Glasgow and the three Scandinavian capitals. Further increases in frequencies will be made if required.

* * *

Mr. C. A. Robinson, A.F.R.Ae.S., has been appointed to the post of Divisional air-traffic control officer, London and South-Eastern Division, in place of Mr. G. H. J. Jeffs, M.B.E., O.B.E., who was recently appointed airport commandant at Prestwick. Mr. Robinson was previously D.A.T.C.O., Northern Division. He is an experienced Service pilot and also holds a "B" Licence.

* * *

In view of the M.C.A.'s refusal to sanction the £500,000 improvement scheme for Doncaster municipal airport, the Sheffield and Doncaster Corporations and Chambers of Commerce are to be invited to discuss the future of the airport. Sheffield Corporation is known to be interested in developing the airfield, at present used by the R.A.F., to serve communities in south Yorkshire.

* * *

At the suggestion of users, the Aerad Flight Guide, produced by International Aeradio, Ltd., has now been redesigned. Formerly presented on a sectional basis, information is now categorized for each individual country; data for 110 countries are now available to subscribers. This compact "aeronautical information service" includes details of radio, lighting, runways, approach and landing control facilities, meteorological data and distress procedures.

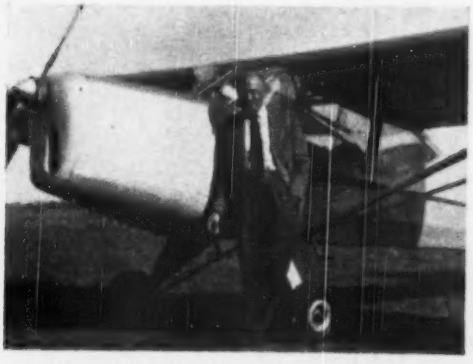
* * *

During 1949, the Dutch airport of Schiphol handled some 327,000 passengers and 17,414,000 lb of cargo. The total number of movements was slightly less than in the previous year, mainly owing to the facts that larger aircraft are now in use and that a certain amount of inland air traffic was suspended during a considerable part of the year. The new 5,000ft north-south runway was put into operation on December 29th and the east-west runway has been lengthened to 6,400ft.

FROM the CLUBS

DURING the two weeks ended January 26th, the Wiltshire Flying Club flew a total of 160 hr 40 min instructional flying, which it claims as a probable record at this period of the year. For the month of January a total of 215 hr 30 min was recorded.

Members are reminded that, with effect from February 1st, solo flying in the two-seat Auster is available at the special rate of £2 10s per hour.



KEEPING YOUNG: Having qualified for his "A" licence in August, 1947, at the age of 53, Mr. W. Fuchs, of Chelsea, is still flying actively. He is a member of the Luton Flying Club and has, up to now, "gone solo" on three types of aircraft.

Captain Spencer Smith has now taken delivery of a Magister G-AHXP, which, with its special finish of medium metallic blue with dark blue lettering, is an aircraft of unusually smart appearance.

* * *

LUTON Flying Club announces that, after many months' delay, work has finally started on the club-house and that it should be possible to move to the new premises at the beginning of April. There will be a large bar-lounge, dining room, billiards room and residential facilities. The club has also acquired a hangar and hopes that many private owners will make use of its hangarage and servicing facilities. M.C.A. approval for the Private Pilot's Course was recently received.

* * *

THE award of a Silver "C" gliding certificate was recently made to Mr. S. R. Dodd, an aeronautical engineer of the Napier Engine Co., Luton, who is an instructor at No. 106 Gliding School, Henlow. To gain a Silver "C" a pilot must soar for five hours in the air 3,300 ft above his point of release and also travel 40 miles from his starting point. Mr. Dodd achieved the first two legs (height and distance) in a London Gliding Club Gull IV sailplane; the final leg (endurance) was completed in a Baby Grünau.

* * *

FOR the six months ended December 31st, the Broken Hill Aero Club of Australia flew 831 hours. Six pupils began their solo flying. From 45 applicants for the flying scholarship, Mr. A. L. Paton was chosen as the winner; the club also secured a number of new members from the unsuccessful applicants. Some friendly rivalry between members has been noticed in altitude flights; Mr. P. Strain recently reached 17,500 feet, thus establishing a club record. The official light-aircraft record for Australia is held by Mr. J. Kingsford-Smith with an altitude of 20,100 feet.

GUILD TEST PILOTS DINE

Fifty Present at First Annual Gathering

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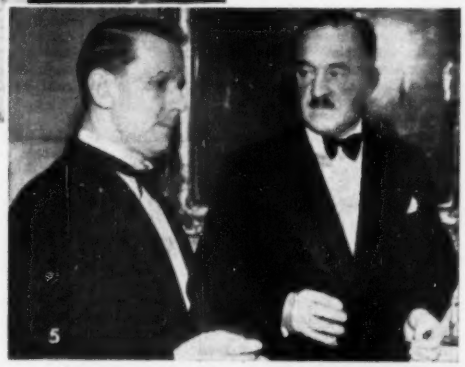


SUCH was the success of the first dinner of the Test Pilots' Section of the Guild of Air Pilots and Air Navigators that everyone expressed the hope that it will be possible (as is the intention) to make this an annual affair. Held at Stanhope Gate, London, last Friday, the dinner was informal; the Royal toast was proposed by Mr. Geoffrey Tyson, a warden of the Guild, and that of "The Guests" by Mr. J. A. D. Scott; A.Cdre. H. L. Patch replying. Sir Archibald Rowlands, Permanent Secretary of the Ministry of Supply, G.C. P. W. S. Bulman, and Mr. E. C. Bowyer (S.B.A.C.) were additional, off-the-record speakers. (1) S/L. A. R. Moore, D.F.C., and Mr. W. B. Price-Owen. (2) Mr. G. A. V. Tyson with A.Cdre. H. L. Patch, C.B.E. (3) The Guests seated at dinner. (4) S/L. J. S. Booth, D.F.C., and Sir John Buchanan. (5) S/L. H. A. Marsh, A.F.C., and W.C. G. E. Lowdell. (6) Mr. E. C. Bowyer, Mr. J. E. D. Scott and S/L. T. S. Wade, D.F.C., A.F.C. (7) Mr. L. A. Wingfield and G/C. W. N. Cumming, O.B.E., D.F.C.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in their columns. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Runaway Junkers

IN reply to the letter from Mr. D. J. Taylor, published in *Flight* of January 26th, requesting the history of the Junkers Ju 90 at Farnborough, I may, perhaps, point out that after the war many German aircraft were brought to England for flying trials, including this Ju 90. After several months' flying and the German Aircraft Display in November, 1945, the majority of the aircraft were broken up.

However, this particular Ju 90 was towed up to the hill where it now stands, but only at the second attempt, as after the first "ditching" it rolled down the slope and across the runway. This accounts for its now being placed behind trees, which will act as brakes should it again break away.

Reading, Berks. BRIAN H. WEBB.

[This appears to clear up the mystery. "For the record," however, the aircraft in question is actually a Ju 290.—ED.]

Opportunity?

I WAS very interested in your editorial, "The Iron is Hot," in the issue of December 1st, 1949, and especially in the last paragraph: "... *Flight* will do all in its power to support those people who have for some time past advocated sending British aircraft such as the Viscount, and later the Comet, for demonstration abroad as soon as it is a practicable possibility."

I would like to ask if consideration has been given to the demonstration of the Viscount, the Comet, the Brab., and the military types—Canberra, Gloster-Avon Meteor, Vickers-Supermarine 510, and Hawker P.1052—at the International Trade Fair in Toronto at the end of May, and at the Canadian National Exhibition at the end of August.

These two fairs are attended by several million people, including buyers the world over. Apart from any orders secured, British prestige would be enormously enhanced.

Since the resumption of the Canadian National Exhibition after the war, daily exhibitions were given by the Vampires of the R.C.A.F. and the Sea Hornets of the R.C.N. I can testify to the tremendous interest in, and popularity of, these flights; how much more so would be a real shop-window display of all the British aircraft mentioned! I do not think it is possible to gauge the tangible or intangible results which might accrue from a really representative showing of British aircraft over here.

It seems to me that the International Trade Fair would be the ideal starting-point for such a showing, with the Canadian National Exhibition the finale, the aircraft being shown at various centres in Canada and the U.S.A. in between—especially in the latter country.

For reasons unknown to me, this suggestion may not be feasible, but I am an Englishman intensely interested in British prestige and the increasing sale of British goods in Canada and the U.S.A. J. L. SYDDALL.

Brantford, Ontario.

Thunderstorm-flying

THERE are many R.A.F. and ex-R.A.F. pilots whose combined experiences of flying in cu-nim, especially in the Far East, might be worth the collection which contributors have recently suggested. I remember that when, in early 1942, four Catalinas of No. 240 Squadron arrived in Ceylon from Northern Ireland, one of the first "facts of life" impressed upon us was that the only way to avoid tropical cu-nim disaster was to fly at 500ft to 800ft—especially at night. This advice was given to us by Hugo Burgerhardt of the Royal Dutch Navy, well known to many R.A.F. pilots in the Far East and later in the United Kingdom. Burgerhardt (now, I believe, test pilot to Fokkers), had had great experience of flying Dornier boats in the Dutch East Indies, and he and Lt. Van Roy (now a colonel in the Dutch Air Force) were very emphatic about this cu-nim avoidance.

I recall departing on one black night from the good advice given, and entering a cu-nim area at 3,000ft in a Catalina. We hit the down-draught, and in what appeared to be a split second we were being hurled downwards on an even keel. Maximum boost and revs, with the stick hard back, had no effect: the climb-and-descent needle was wrapped round the clock and the altimeter unwound with the speed of a jet rev-counter. The aircraft was pushed right down to sea-level, but fortunately held on "the cushion" a foot or so above the whitecaps. The up-draught then took charge, and in a matter of seconds we were up to 4,000ft. As far as I recollect, I.A.S. remained at about 105 knots throughout, and I was completely unable to influence the aircraft in any way.

After that I stuck to the 500ft rule, and although often in pouring rain and heavy but ordinary bumps, never had the elements take charge of the aircraft again. I realize that 500ft is not a practical height for airliners, and that there is a risk at night of hitting an unseen waterspout under the cloud base, but I am certain that there is no really safe refuge to be found in the height band of 500ft to 25,000ft in tropical conditions.

There are many pilots of 205, 240 and 413 Squadrons alone whose varied experience of tropical cu-nim is considerable. I mention only W/C. Bradshaw, now with Transport Command; S/L. Furseman, now Station C.O. at Filton; S/L. Round, now Regional A.T.C. at Bristol; W/C. Hildyard, now at the Foreign Office; W/C. Roberts, who runs an airline in the Caribbean; A.V-M. Plant and G/C. (?) Scott of the R.C.A.F.; and, perhaps most of all, W/C. Stacey, lately Assistant Air Attaché in Washington.

These men, and many others to whom cu-nim was a daily enemy, could, between them, compile a valuable dossier on the tactical problems involved. Perhaps, if this catches their eye, they could be prevailed upon to contribute a note on their experiences.

The menace of these tropical clouds has been proved in disasters, and I can recall several known instances of aircraft entering cu-nim and never being seen again. My own recollection is that, in the neighbourhood of Ceylon, the "line-squall" formations were, on average, some 80 miles long from east to west, and that the accepted drill was always to turn west along the line, and get behind it. One Catalina which tried to get through the centre of such a squall was lost; a second machine, a few minutes behind it, went only through the tail-end, and emerged with many started rivets.

London, W.1. CHARLES GARDNER.

Rocket-propelled Intercepters

I FEEL indebted to Mr. Stanley H. Evans and to *Flight* for the information regarding American progress in supersonic flight research, with particular reference to the Douglas Sky-rocket, contained in your issue of January 5th.

It is to be hoped, however, that British "imagineering" of the rocket-propelled intercepter fighters to come will not follow blindly an American lead. The American continent has its centres of population and of production at distances measured in thousands of miles from bases at present held by a possible aggressor nation. With command of the sea areas around their coastline, the Americans are able to set up advance posts on islands or ahoat, ready to alert their defence system and give a reasonable warning of the approach of enemy aircraft—even those proceeding at 2,000 m.p.h.! The position of the defence system of the British Isles is very different, as anyone who saw the V-2 in action will appreciate. As a nation, we are not even able to rely on radar to assist us with reports of enemy aircraft one hundred miles distant—the present published range of our equipment. Even at this range, radar is subject to screening by metallic foil, easily distributed, or to the danger of being misled by formations of comparatively short-range winged objects of most elementary mechanical form (V-1 style).

Perhaps our local defence needs will best be met by guided weapons, in which case the necessary automatic homing devices will need most development. That job taken care of, we can then put our main aircraft-design effort into producing a really effective offensive machine—which seems logical in any case, since a really devastating attack will probably be our only hope of salvation in the event of another conflict, and the threat of such an attack probably our best protection.

Supposing that we must have manned intercepter fighters, it is suggested that something along the lines of the German BP-20B Natter project may best fit our needs. If this project could be developed into a small, "utility" aircraft, capable of being mass-produced, launched vertically and flown by a pilot in a prone position, valuable seconds on an interception might be saved. Our fighter squadrons are tied at present to airfields mainly sited by topographical considerations. Incidentally, these airfields are all carefully marked on maps that are readily available to friend or to prospective foe alike. Aircraft of the Natter type could be stationed around our coast-

CORRESPONDENCE . . .

line and at other places, being distributed exactly as determined by overall strategy at any time. They could, in fact, be stationed, each with its crew, in a similar fashion to that adopted for balloon barrage units during World War II, and would, of course, be in radio contact at all times with operations headquarters. There are many other ways in which the type could be developed. Some could possibly be fitted with retractable skid-cum-planing bottoms and landed at airfields, on open agricultural land, highways, beaches, or in the sea, as emergency conditions required. Being of small size and of very light weight with all fuel exhausted, the machines would be easily retrieved.

Personally, I feel that as it is now twenty years since enough was learnt about aerodynamics and mechanics to make undercarriage-retraction pay, we should by now have on the way more variable lifting and control surfaces for very high-speed aircraft. Anyway, it seems clear that there is a lot of room for scientific research along lines matched against our own peculiar problems. EDMUND W. COATES.

Leicester.

For Single-Seat Solos

SEVERAL months ago mention was made in *Flight* of a project for the revival of the Chilton D.W.1. From the details given, it appears that the particular firm involved will have to commence work with little or no drawings. As a matter of interest, the Chilton seems to me to be the answer to the club pilot's prayer. It is fully aerobatic and has normal handling characteristics, together with low fuel and oil consumption.

The qualities mentioned make it ideal for group operation, and it would be appreciated by numerous 'teen-age club pilots, who are now paying upwards of £3 an hour for solo flying in trainers normally used for dual instruction. The main requirement is, therefore, a cheap little monoplane with a nice turn of speed, and in the aerobatic category. I am taking for granted the fact that most young club pilots like *solo* flying and do not desire to embark on continual trips around the aerodrome with their girl friends!

There seems little doubt that a demand does exist for a cheap, reliable aircraft for club solo practice. Difficulties surround the manufacture of such a machine, but in the case of the Chilton they are only in a fresh set of drawings, which, I understand, do not exist. Work would start with fresh drawings taken from one of the two remaining examples.

Finally, I would point out that my interest in the aircraft mentioned is purely from the flying side, and that I am not connected with the manufacturers of the Chilton in any way whatsoever. LEWIS G. COOPER.

Bulawayo,
Southern Rhodesia.

[Revival of the Chilton has been advocated on several occasions. Preparing a full set of drawings from an existing aircraft is, however, a fairly formidable task.—ED.]

Unchronological Order

UNLESS my eyes deceive me, the photograph on the wall behind the "film" portrait of Mr. W. E. P. Johnson (published in *Flight* of January 26th) shows the first take-off ever made "under the hood." The date, I believe, was June, 1931, and the pilot of the Avro 504N was none other than Mr. Johnson, who was then an instructor at C.F.S., Wittering.

As this particular scene from the C.O.I. *Wonder Jet* film was intended to show Mr. Johnson as he was in 1926, when an instructor at Cranwell, the 1931 picture is rather a give-away. One always imagined that film studios employed specialists, at vast salaries, to prevent such anachronisms occurring!

Paisley. L. McARDLE.

[Our correspondent is right about the time and place. *Flight*'s chief photographer took the picture.—ED.]

Sensitive Ears, Short Sight

ONE notes that Councillor F. Clapham of Wolverhampton (a city with important aircraft and aircraft-accessory firms, a most active flying club and a first-class Reserve school) is reported to have described flying training there as an "ever-present danger and an intolerable nuisance." A letter from the "Residents' Defence Society" (one feels that the quotes should be round the word "defence" alone) says that flying training has been a source of complaint for eleven years.

A lot of things, such as wars and getting up on a cold morning off to go to an airfield for voluntary flying training, are also a nuisance and a cause for complaint of one sort or another.

Your readers may recall my previous letter, and for any interested in the possibilities of another air attack on these islands, I shall be glad to send copies of a map I am preparing, chiefly for Air Force use, indicating small areas—such as the habitat of certain councillors and of a few disgruntled residents—which, in my opinion, need not be defended.

London, N.W.4. A. JACKSON

AIRCRAFT for the ARMY

A General's Views on Past Successes and Future Requirements

A LUCID exposition of the Army's requirements for aircraft was given in a Paper read before the Royal United Service Institution in London on February 1st by Lt.-Gen. R. N. Gale, C.B., D.S.O., M.C. The wartime posts held by the lecturer, who is now Director-General of Military Training, included that of Director of Air, War Office, and the command of the 6th Airborne Division at the time of the Normandy landings.

Gen. Gale began by instancing this and other operations in which airborne assault had been of decisive value; he said that in Normandy the airborne force had been able to seize the high ground to the east of the River Orne in a matter of hours, whereas the assault columns to the west had taken several days to achieve a comparable result, and at heavy cost.

Aircraft were of value to the Army for a number of purposes, which included those of swiftly depositing troops and supplies in fighting areas; providing speedy personal transport for commanders, liaison officers and others between front and rear areas; A.O.P. work; and casualty evacuation.

Quite often, said the General—he gave examples—the use of airborne troops was feasible even when air supremacy had not been won. Accuracy in navigation, however, was essential, and some earlier failures during the war taught valuable lessons. As an instance of what could be achieved, he recalled a 1945 operation in Holland, when Special Air Service troops were to be dropped in ten different parties. The late A.V.-M. Scarlett Streatfeild, A.O.C. 38 Group, telephoned a few hours before the operation to say that, while 10/10 cloud was expected, he estimated that the use of Gee would enable each party to be dropped with a maximum error of a mile in one direction and two miles in the other. In the event, all the parties were put down within these limits, 780 men being dropped with only five accidental casualties.

The lecturer said that in the design of transport aircraft all sorts of problems arose, and only people with practical experience of loading could know the difficulties. They wanted aircraft that, by ease of exit and the ability to fly slowly, could drop the shortest possible stick of parachutists; that could use "inadequate" airfields; and that were equipped with efficient navigational devices.

Turning to the rôle of the glider, Gen. Gale said that where a heavily armed concentration of force was required, it was superior to sticks of parachutists; looking to the future, however, he confessed that he would not be sorry to see the last of this "unscientific and clumsy adaptation" if something better could be devised. Could we adapt the great weight-lifting capacity of modern transports so that they did not require a mile or more of concrete runway? If it was aerodynamically practicable, the heavy-weight-lifting helicopter might be another answer.

On the subject of light aircraft for A.O.P. and communication duties, the lecturer gave an entertaining account of the Auster's early soldiering. The War Office put up a specification for a light artillery-reconnaissance aircraft; the Air Staff accepted it, and, with a view to experiment, ordered three Stinsons from America. The Stinsons came by sea, but had to share the hold with a cargo of cheese; on arrival, they were not merely unusable, but unrecognizable.

The Air Staff then offered the Taylorcraft with a 60 h.p. engine. The Royal Regiment of Artillery "hated it," so Gen. Gale saw the late Air Marshal Linnell, who suggested that the little machine had hardly been given a fair trial. A more powerful interim engine was fitted while Lycomings were awaited, and the aircraft, now known as the Auster, began to gain favour. It soon became indispensable. "In Malaya today," said the lecturer, "it is worth its weight in gold."

General Gale's lecture concluded with a brief summing-up by the chairman, Air Marshal Sir Leslie N. Hollinghurst, K.C.B., K.B.E., D.F.C.

SERVICE AVIATION

Royal Air Force and Naval Aviation News and Announcements

Senior Appointments

THE following R.A.F. appointments are announced by the Air Ministry:—

A.V-M. E. J. Kingston-McLoughry, Senior Air Staff Officer, Fighter Command, since 1948, to be A.O.C. No. 38 Group, Transport Command.

A. Cdre. D. F. W. Atcherley, until recently Commandant of the Central Fighter Establishment, to be Senior Air Staff Officer, Fighter Command, with the acting rank of Air Vice-Marshal.

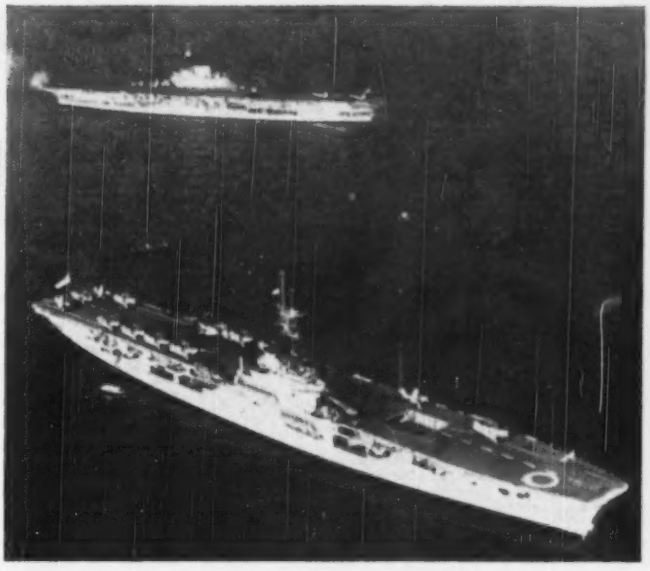
The Air Ministry also announces the appointment of A.V-M. Sir Harry Broadhurst, K.B.E., C.B., D.S.O., D.F.C., A.F.C., as Senior Air Staff Officer, British Air Forces of Occupation, Germany, in place of A-V.M. C. S. Spackman, C.B.E., D.F.C., who is retiring from the Royal Air Force.

Vampire 5 at Singapore

A DE HAVILLAND Vampire 5 fighter-bomber is now being assembled at the Far East Maintenance Base at Singapore, and will shortly begin trials. Last year a Mk. 3 Vampire was successfully flown under tropical conditions.

The Latest "Sunray"

TWELVE Lincolns and three Mosquitoes of Bomber Command flew from R.A.F. Stations Binbrook and Coningsby on February 2nd on a 2,000-mile "Sunray" flight to Shallufa, Canal Zone.



SPRING CRUISE: The carriers *Vengeance* (nearer) and *Implacable* leave for "Gib."

Thirty Cranwell Years

IT is thirty years—on February 5th, 1920—since the Royal Air Force College, Cranwell, Lincs, was opened, under the command of Air Commodore C. A. H. (later Air Vice-Marshal Sir Charles) Longcroft. It was inaugurated for the dual purpose of creating an Air Force spirit and of training permanent officers for the General Duties (flying) branch. A few months before the opening, Marshal of the Royal Air Force Lord Trenchard had written in a memorandum on the subject to his Secretary of State, Mr. Winston Churchill, "It is not sufficient to make the Air Force officer a chauffeur and nothing more." The College aimed from the start to train officers not only to fly, but to be the leaders of the Air Force of the future.

Of the 34 surviving graduates of the first entry, 13 now hold Air rank in the Service—five Air Vice-Marshals and eight Air Commodores. The Air Vice-Marshals are: N. H. D'Aeth (Air Officer Commanding, Air H.Q., Malta), G. R. C. Spencer (shortly to become A.O.C., No. 19 Group, Coastal Command), C. W. Weedon (Director-General of Engineering, Air Ministry), W. A. D. Brook (Chief of Staff to the C.-in-C., Air Forces, Western Europe), G. Combe (shortly to take the post of President of the Ordnance Board) and G. H. Mills (A.O.C., No. 1 Group Bomber Command). The remaining seven members of the first entry who are still in the Service hold the rank of Group Captain. Up to the outbreak of war, just over 1,000 officers had graduated at Cranwell.

On July 6th, 1948, His Majesty the King, who served at Cranwell in 1917-18, presented to the College the first King's Colour to be presented within the R.A.F.

As related above, the Royal Air Force College, Cranwell, is celebrating its 30th birthday. This *Flight* photograph, taken 16 years ago, shows the famous main building as it looked in the days before it suffered damage from a German bomb.

R.A.F. Living Conditions

ADDRESSING a thousand airmen and airwomen at Boscombe Down on the occasion of the opening of the new dining hall, reported last week, the Henderson, said that the object of the Secretary of State for Air, Mr. Arthur Government and the Air Council was to provide the men and women in the three Services with living conditions comparable with civilian standards. Too often in the past Service living conditions had compared most unfavourably with living conditions in civilian life. There was no reason at all why this should be so. The men and women in the Services were a part of the general community, and as such were entitled to equal living standards. Since the war ended 53 barrack blocks, housing over 5,000 airmen and airwomen, had been, or were being, constructed. This accommodation was of a very high standard of comfort, and Mr. Henderson's only regret

SERVICE AVIATION . . .

was that even yet a considerable proportion of airmen and airwomen were having to live in conditions which did not yet attain this standard. Unfortunately it had been necessary to retain in use many of the hutted camps which were built for war purposes and were not intended for peacetime occupation. But as quickly as circumstances permitted more and more accommodation of the modern type would be built.

Seven Professionals

R.A.F. Station, Hereford, has a football team which could compete in the First Division, including as it does seven professionals and one ex-professional. The forward line alone would represent at present high-level transfer fees a very considerable figure.

The goalkeeper is a West Ham player, Cpl. P. Chiswick. Professionals in the half-back line include A/C. C. Poxon, of the Ashington (North-Eastern League F.C.), and A/C. F. Boyd, of Berwick Rangers. The forward line includes Cpl. F. Hardy, a former member of the Shrewsbury Town F.C., A/C. I. McMillan, of the Airdrieonians F.C., A/C. S. Smith (Aberdeen F.C.), A/C. C. Ware (York City) and A/C. M. J. Boxall (Guildford). Hardy and Boxall are Regular airmen and the others are National Servicemen.

Territorial and Auxiliary Forces Association

THE first meeting of the Air Advisory Committee of the Council of the Territorial and Auxiliary Forces Associations was held at the Air Ministry during January. The Air Advisory Committee has been set up as a liaison body between the Council of Territorial and Auxiliary Forces Associations and the Air Ministry, and contains representatives of both sides; in particular, it will advise the Air Council on questions affecting the Auxiliary and Reserve Forces. The Secretary of State for Air, who opened the meeting, said that he was sure the Committee would serve a most useful function in strengthening the already close relations which existed between the Air Ministry and the Council of the T.A.F.A.S. and in helping to resolve the very difficult problems with which the Auxiliary and Reserve Forces were faced at the present time.

The present membership of the Committee is as follows: *Air Ministry Members:* The Air Member for Personnel: Air Marshal Sir Leslie N. Hollinghurst, K.C.B., K.B.E., D.F.C. (Chairman); The A.O.C.-in-C., Reserve Command, Air Marshal R. M. Foster, C.B., C.B.E., D.F.C. *Council of T.A.F.A. Members:* The Rt. Hon. the Earl of Limerick, K.C.B., D.S.O., T.D.; Air Marshal Sir Robert Saundby, K.B.E., C.B., M.C., D.F.C., A.F.C.; Air Marshal Sir John Baldwin, K.B.E., C.B., D.S.O.; Major-General the Viscount Bridgeman, C.B., D.S.O., M.C., D.L.; Sir Herbert Creedy, G.C.B., K.C.V.O., Air Vice-Marshal G. H. Ambler, C.B., C.B.E., A.F.C.; Group Captain A. S. W. Dore, C.B., D.S.O., T.D., D.L.; Air Chief Marshal Sir Richard E. C. Peirse, K.C.B., D.S.O., A.F.C.

Special Dispensation

THE Society of Apothecaries has agreed to admit direct to its examination for assistants in dispensing candidates from the R.A.F. who have satisfactorily completed the nine-month course at the R.A.F. Medical Training Establishment's school of dispensing. Examinations are held quarterly. The Society's certificate normally enables the holder to obtain civilian employment as an apothecary's assistant.

Seletar Scouts

ROVER Scouts belonging to the 17th Singapore Scout Group, which has been formed at the R.A.F. Maintenance Base (Far East), Seletar, recently sent nearly 700 toys to the Children's World Community Chest, London, for distribution among the destitute children of Europe. They included 430 wooden toys and 250 cloth toys. In addition to a Rover crew of 25, most of whom are airmen who were Rover Scouts before they joined the R.A.F., the group includes a senior Scout troop, a junior Scout troop, and a Wolf Cub pack, members of which are the sons of officers and airmen stationed at Seletar, and Malay boys living in the civil lines and working in the storage sheds and workshops as messengers and instrument repairers.

FOUR ON A FIREFLY: Favourable reports on the capabilities of W.R.N.S. aircraft mechanics have persuaded the Admiralty to afford them the same training as men in Mechanics (A) and (B) categories of Naval Aviation. Four trainees are seen ministering to the Rolls-Royce Griffon engine of a Fairey Firefly trainer.

R.A.F. Appointment

THE Air Ministry announces that Air Commodore Alfred Randles Wardle, C.B.E., A.F.C., is shortly to take over the post of Air Officer Commanding No. 66 (Scottish Reserve) Group, in place of Air Commodore E. S. Burns, C.B.E., who is retiring from the active list.

Air Commodore Wardle, who was born in October, 1898, has recently returned from Ceylon, where he was Air Officer Commanding from February, 1947. Previously he was Director of Operational Requirements (A) at the Air Ministry, being appointed to this post in April, 1943, after having served for nearly two years as a deputy director. At the outbreak of the war he was an administrative staff officer at Reserve Command H.Q. He became an air staff officer at Technical Training Command H.Q. in May, 1940, and at the end of that year was appointed Senior Air Staff Officer of No. 21 Group, where he remained until he went to the Air Ministry in July, 1941. In the first world war Air Commodore Wardle served in the ranks of the Honourable Artillery Company and afterwards as an officer in the Royal Flying Corps, transferring to the R.A.F. on its formation in 1918.

Air Commodore Burns has commanded No. 66 Group since May, 1947, and was formerly Director of Personal Services at the Air Ministry. He was born at Cheltenham in July, 1899, and was given a permanent commission in the Royal Air Force in 1922 after leaving Cambridge University, where he went in 1919 after having served in the R.A.F. from April, 1918, and previously in the Royal Naval Air Service for a short period after leaving Mill Hill School in 1917.

Flying-boat Exchange Plan

R.A.F. Sunderland flying-boats of No. 88 Squadron, famous for its part in the relief of H.M.S. *Amethyst* last April, are changing places for two months with two Catalinas of No. 5 Squadron, Royal New Zealand Air Force.

The New Zealand aircraft, with their servicing crews, left Lauthala Bay, Fiji, on January 26th and were due to arrive at Kai Tak, Hong Kong, on February 2nd. The two Far East-based R.A.F. Sunderlands will leave shortly with their ground crews to arrive at Lauthala Bay, via Auckland, New Zealand, on February 16th.

Reunions

THE Coastal Command Officers' Reunion Dinner (1939-45), will take place at the Connaught Rooms on May 13th. Tickets from W/C. E. G. Palmer, Ministry of Supply, Room 4011, Thames House (South), Millbank, S.W.1. Cheques or money orders for 15s 6d, made out to "Coastal Command Officers' Reunion Dinner" should be forwarded with application.

* * *

All ex-members of No. 106 Squadron (male and female), with one guest, are invited to a reunion dinner to be held on March 4th. Further particulars obtainable from S/L. F. Combie, R.A.F. Brize Norton, Carterton, Oxon.

* * *

No. 3 B.F.T.S. (R.A.F.) late of Miami, Okla. Third annual reunion at the Connaught Rooms, W.C.2, on Saturday, March 11th, 1950, at 6.30 p.m. Tickets ("stag") from H. V. D. Hallett, 22, Leigh Road, Eastleigh, Hants, 18s each.

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Z.5646	Cirrus Minor II	Auster V.J.1.
Z.5800	Cirrus Minor II	Auster V.J.1.
Z.5671	Gipsy Major X	K.Z.4.
Z.5672	Gipsy Major X	K.Z.4.
Z.5704	Cirrus Minor II	Miles Gemini.
Z.5721	Continental C.125.1	K.Z.III.
Z.5790	Continental C.85	Auster.
Z.6013	Cirrus Major III	Messenger, Aerovan.
Z.6014	Cirrus Major III	Messenger, Aerovan.
Z.6021/1	Gipsy Major I	K.Z.II.
Z.8010/1	Gipsy Major I.D.	Messenger.
Z.8010/1	Gipsy Major 10	Christea Super Ace.
Z.8022	Cirrus Minor I	Auster J.4, Taylorcraft D.
Z.8040 (replacement for DES.86 CA.69)	Warner super Scarab	Fairchild Argus I.
DH.5220/P	Gipsy Major I	DH.82 (Tiger Moth) DH.82A (Tiger Moth Trainer).
DH.5220/H	Gipsy Major I	As above and DH.83 (Fox Moth), DH.84 (Dragon).
DH.5232/A	Gipsy Major I	DH.84 (Dragon), DH.85 (Leopard), DH.82A (Tiger Moth Trainer), DH.90A (Puss Moth), DH.83 (Fox Moth).
DH.5234/J	Gipsy Major I	DH.87B (Hornet), DH.85 (Leopard).
DH.5250/B	Gipsy Major I	DH.90A (Dragonfly).
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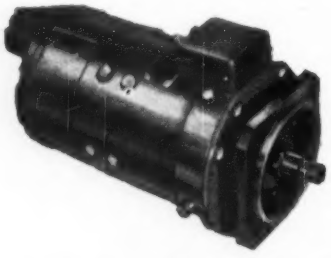

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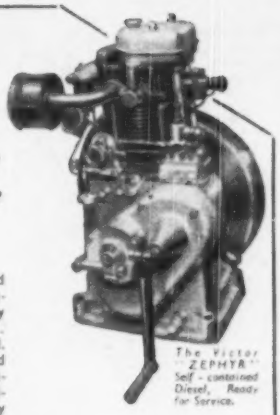

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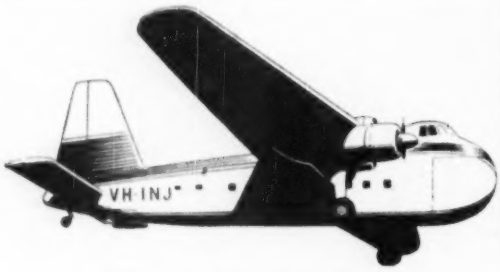

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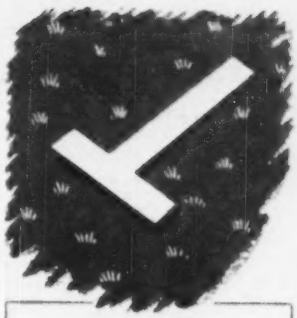

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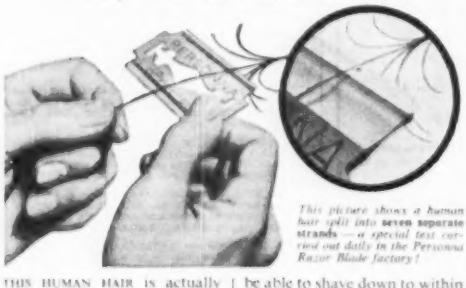

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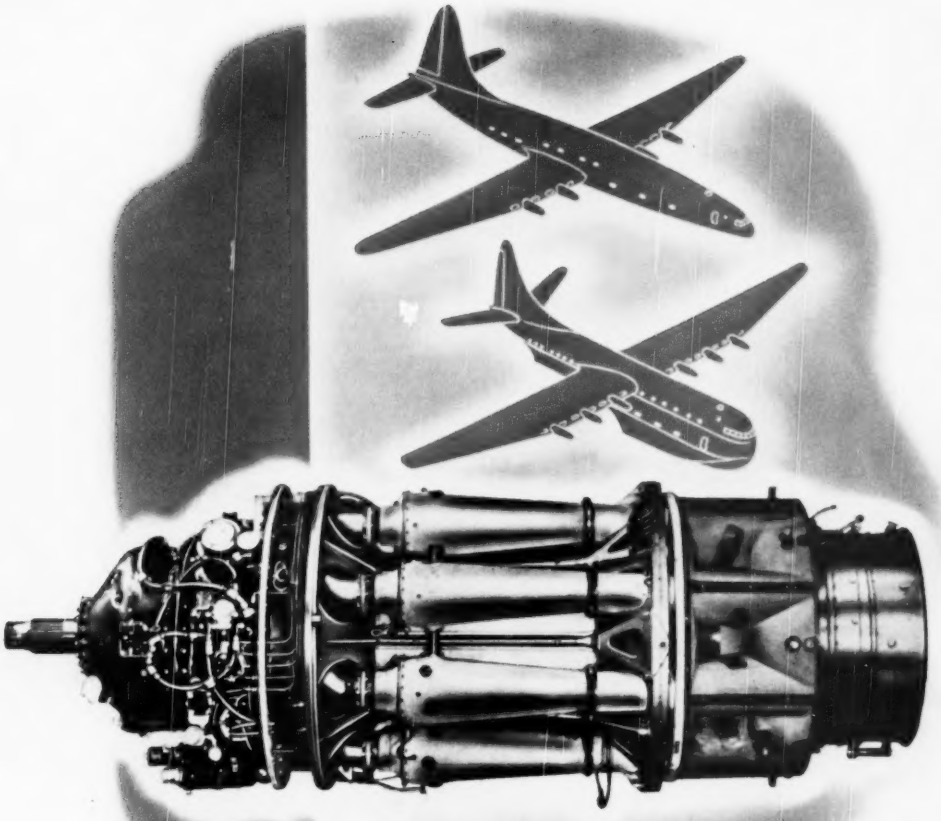

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